

The Way Forward >>>

Higher Education Action Plan for the Information Economy

This paper is part of the *Education and Training Sector Action Plan for the Information Economy* prepared by the EdNA Reference Committee, an information technology policy body that reports to the Australasian Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). It was developed in 1999 by the Higher Education I.T. Consultative Forum (an advisory group to the ERC), and approved by Australian Vice-Chancellors' Committee and its Standing Committee on Information Policy on behalf of the Australian higher education sector. The paper has been considered by the cabinet of the Australian Commonwealth Government. In March 2000, MCEETYA supported the broad directions of the *Education and Training Sector Action Plan for the Information Economy*, and noted *The Way Forward* as part of that Plan. Various higher education I.T. policy bodies are now exploring ways of taking its recommendations forward.

The Challenge

Given the flexibility and means to do so, universities will be the fundamental drivers for the Australian information economy, which is largely knowledge-based. Today's higher education students will become tomorrow's leaders, innovators, managers and researchers. They will shape Australia's place within the world economy.

In recent years higher education institutions, along with government and the rest of the community, have strained to come to grips with new issues arising from rapid developments in information technology and communications (IT&C). Time and resources to explore the new issues have been limited. Further policy work is required on technical and policy options that will enable universities to give students access to cutting edge information technology, research training and advanced applications that are essential for the information economy. Without this Australia runs the risk of:

- significantly reducing direct export earnings from education earnings and indirectly from other industries;
- becoming a major importer of skills, intellectual knowledge, IT infrastructure and computer applications;
- being less attractive to investors and industry seeking affordable, advanced information technology infrastructure and skilled people to work within and take advantage of this infrastructure;
- losing its reputation as an advanced economy with highly developed research skills, institutions and workforce; and

- losing its best minds to other countries.

Within this context this paper seeks to:

- briefly describe the background to higher educational involvement with information technology and communications;
- demonstrate the initiatives currently being undertaken by Australian universities to maximise their participation in the information economy; and
- identify strategic directions that would enable Australia to be at the forefront of developments in the information economy.

Background

Historically, Australian higher education institutions have been fundamental drivers in the development of information technology in Australia. Universities have combined high-level technical skills with advanced research, pioneering technologies and high-quality infrastructure. In 1989 AARNet was one of the first academic computer networks in the world and its existence and the skills of its technicians enabled Australia to be an early adopter of Internet technologies and applications. Australia is renowned for its software programming skills and for innovative niche hardware.

Australian higher education institutions have also made a major contribution to Australia's broader research and development effort. Many of the innovations that have created the information economy in Australia originated either from higher education institutions or from people with advanced research skills and intellectual capacity trained by them.

In recent years universities have experienced severe resource constraints, but despite this universities have endeavoured to provide students and researchers with access to the cutting-edge tools and infrastructure that allow for further knowledge creation.

Existing Initiatives

Universities are early adopters of commercial computer applications, using them for administrative, research and teaching purposes. E-mail was used by academic staff well before its broader acceptance. Spreadsheets and office applications are widely used, and statistical and other packages are frequently tested within universities at an early stage.

Australian universities are using the Internet to deliver quality distance education to students within Australia and overseas. In some Australian universities a majority of students take courses through distance education, which increasingly involves using the Internet for tutorials, lodgement of assignments, delivery of course material and communication between

students and their lecturers. Such students are increasingly being drawn from professional organisations and industry.

Administrative systems within universities are complex, covering academic, financial, administrative and legal matters. Australian universities have some of the most advanced systems in the world and initiatives are being made to extend these and to test new technologies. For example, Adelaide University and the Australian Defence Force Academy (University of NSW) are both working with Telstra to trial the use of rechargeable telephone card technology for multiple purposes, including student ID, library borrowing, photocopying, security, and student payments.

Industry has drawn on universities both as a source of skilled staff and to provide training and further education to existing staff as the need for life-long education increases. Such training includes management courses and specially-tailored industry-based courses. Partnerships are emerging for the delivery of specific programs where industry has neither the skills nor means to deliver high-quality education programs to its employees.

Higher education institutions have also been incubators for new technologies, products and applications, as well as testbeds for these as they move towards the marketplace. Sydney University academics have developed software relating to share transactions for the Australian Stock Exchange. Sydney University, the University of Technology Sydney and the University of NSW have been involved in the Australian Technology Park, which provides complex design and modelling using small advanced computers for a range of industries, saving time and development costs in the transition from prototype to final product.

Higher education institutions provide students, research professionals and academics with the skills to exploit and advance new technology more quickly than any other sector of the economy as they are constantly seeking to apply new technologies to the work at hand.

Strategic Priorities

Although higher education institutions continue to make major commitments to new information technologies, significant opportunities are going untapped, and critical issues of a technological and policy nature need addressing by universities, by industry and by policy makers in order for Australia to remain an internationally competitive economy. These strategic priorities can be addressed under the five interrelated Action Areas outlined in the *Education and Training Sector Action Plan for the Information Economy*:

- People
- Infrastructure
- Content, applications, delivery and services
- Organisational and Policy Framework
- Regulatory Framework

People

Context

Education in Australia is a multi-billion dollar export industry of vital importance to our economy. As well as being a consumer of information technology products and services, education is a major provider of services using information technology and communications.

Australian universities are using information technologies to improve administration, research, and teaching and learning.¹ Individual universities, lecturers, academics and trainers each respond to their responsibility to develop the broad flexible learning capabilities required in the information economy in their own way. There is evidence, however, that information technology applications have not penetrated university teaching at more than a superficial level, and that the level of expertise and practice is not yet sufficient to ensure that their wider use is considered viable by academics for developing and delivering courses. Consequently, Australia risks falling behind its overseas peers and competitors, threatening our access to advanced computing initiatives and early implementation of new hardware, software and applications. This in turn could lead to a reduction in staff skills compared with our overseas competitors.

A further concern is that the preparation by Australian universities of its graduates for work within the information economy is often so effective that many are recruited overseas. This leads to a drain on the national skill base and within universities in particular.

Restrictions on linkages between universities and other institutions are also preventing certain natural linkages from being fully developed. For example, while universities are heavily involved in the education, research training and teaching of hospital and medical staff, they are unable to easily develop infrastructure linkages which would improve on-going teaching and research.

Strategic Priorities

Encouragement of universities to ensure that their graduates enter the workforce with the competencies needed, including information literacy skills and lifelong learning skills

The development of specialised courses and online materials that integrate information technology with mainstream disciplines will strengthen Australia's position as a leader in education, both online and overall. To avoid falling behind other advanced economies, Australia must ensure that:

¹ *Managing the Introduction of Technology in the delivery and Administration of Higher Education, Evaluation and Investigations Program*, Higher Education Division, DEETYA, 1997, p. 21.

- graduates enter the workforce with the information technology literacy and lifelong learning skills needed in the information economy; and
- advanced IT skills and applications are applied in disciplines such as biotechnology, marine science and chemistry so that Australia can make new advances in areas of strategic importance to the economy.

Collaboration between universities should be encouraged, particularly where resources are limited and no one university can meet what is required; for example, the AVCC believes that the resources needed for advanced computing (sometimes referred to as high performance or supercomputing) are so specialised that some of them will have to be centralised through the Australian Partnership for Advanced Computing (APAC).

Provision of adequate numbers of graduates who can design and develop the systems and technologies needed to position Australia within the global information economy

Australia is renowned for producing graduates with high-quality software development and programming skills. Australian industry exports many products developed with their skills. The demand for such skills needs to be carefully monitored, and universities provided with the means to develop new courses quickly in response to the changing needs of industry.

Information technology is also being applied to existing industries to improve productivity and reduce costs. Demand for skilled IT personnel will continue to grow, and there is some concern that it may not be able to be met. Research and development personnel within universities, research institutions and industry are also having to develop both strong IT skills and expertise in particular areas of science and industry. The development of new multi-disciplinary degrees linking advanced IT skills to particular disciplines is one option being explored by some universities. The potential to develop more information technology graduates is also a priority for Australian universities.

Cooperation with industry to develop modularised, flexible teaching and learning resources to support lifelong learning, possibly in an industry or online rather than campus based setting

Industry is increasingly accepting that the public education and training sector cannot carry the total responsibility for solving the shortage of IT skills. Not only are the lead times between identifying a need and the ability of the sector to develop courses and put students through them often too long, but some skills are so narrow that they need to be developed on-site. Longer-term issues regarding the skills required by individual graduates and the likely workforce requirements for such skills, on the other hand, can only be met by careful collaboration between educators, trainers and industry personnel. Universities will seek to cooperate with industry and professional bodies to:

- review the skill and knowledge requirements in each profession;

- review current courses leading to professional accreditation to ensure they have sufficient content in relation to computing, information technology and information systems;
- develop modularised, flexible teaching and learning resources to support lifelong learning;
- review and amend current enrolment policies and limits to ensure adequate numbers of graduates can be attracted and trained to design and develop the systems and technologies needed to position Australia within the global information economy.

Professional development programs to meet skill shortages and ensure staff continue to have their skills upgraded to take advantage of new opportunities presented by new technology

For universities to be able to supply the skills necessary to drive the information economy, they must:

- have staff with the vision and skills to make use of new technology, new applications and new approaches to learning; and
- provide professional development for lecturers, administrative staff, technical assistants, researchers and other staff to allow them to be change agents in achieving the goals of the information economy.

Much of this may well be possible through online education. In some cases university staff will require training from colleagues in other disciplines as the significance of new applications discovered in one discipline for others becomes clear.

Ensure that women are fully involved in the use and development of information technology in higher education

As in some other technical disciplines, there is a danger that women will remain under-represented in the use and development of IT&C in universities, both as students and as staff. Adequate steps must be taken to ensure that women can take full advantage of the promise of information technology for higher education teaching and research.

Responsibility

While universities have the primary responsibility for professional development of their staff within their resource constraints, the preparation of graduates for the workforce through well-designed course or subject materials is the shared responsibility of universities, industry and government.

Physical Infrastructure

Context

The academic community was an early implementer and adopter of computer networks, using them for data transfer and e-mail long before the introduction of the World Wide Web. There is evidence that Australian education computer facilities and networks are falling behind overseas peers and competitors, particularly in regards to access to adequate advanced information infrastructure, including high bandwidth.² In contrast to Australia, federal governments and industry in a number of G7 and other countries have provided millions of dollars towards the development of new advanced networks such as the Next-Generation Internet, Internet2, the Very-high-speed Backbone Network System (VBNS), and CANARIE (Canada's Optical Internet Initiative). In Canada, optical fibre is being run out not just to universities but also to schools at a fraction of the cost of acquiring capacity from a carrier.

The Australian Academic and Research Network (AARNet) was founded in 1989 to improve research through linking Australian scholars with each other and with overseas researchers and through access to global information resources.

AARNet interconnects eight Regional Network Organisations (academic and research networks), one in each of Australia's six states and two main territories. Universities and other major Commonwealth research organisations such as the CSIRO connect to their nearest RNO either by private microwave radio systems or by leased telecommunications links. Microwave connections are currently cheaper than connection through the telecommunications infrastructure of major carriers. Connection rates of most universities to their RNO vary between 34 and 155 Mbps (megabits per second). The high cost of connection via carrier infrastructure precludes five universities from being connected to Regional Network Organisations by broadband connections. These universities are connected by leased lines at approximately 2 Mbps.

AARNet members are linked to the Australian domestic and international Internet via major Internet service providers both in Australia and overseas. The highest cost component of AARNet connectivity is currently trans-Pacific capacity. This is causing a dampening of demand; however, the trans-Pacific costs are expected to reduce significantly in the next 12-18 months as new high-capacity undersea cable links are deployed.

AARNet is capable of carrying voice and video services as well as data. Network performance is acceptable for most current applications and is reinforced by service-level agreements with Optus. Certain applications, however, will require dedicated and/or other quality-of-service characteristics that are problematical for AARNet to deliver.³ This will

² *Bandwidth Requirements for the Australian Education and Training Sector*, Australian Commonwealth Department of Education, Training and Youth Affairs, August 1999, pp. 11-12.

³ *High Performance Computing and Communications in Australia*, Higher Education Division Occasional Paper Series, 1998, p. 39.

remain the case unless significantly more affordable bandwidth is made available and other workgroup, institutional and regional network upgrades are implemented. In addition, users outside of AARNet, such as those at TAFE and research and production facilities within industry, may need to access course materials such as multi-media courseware, applications or data from within the AARNet community; these users are dependent on the performance of their organisation's network and their connection to the Australian or global Internet. Given that some multimedia applications may require up to 10 Mbps, the inadequacy of current arrangements is clear.

How Australian universities and research organisations can make such an investment and provide the necessary advanced information and communications infrastructure to their communities and clients is a key issue both for them and ultimately for Australia. In the USA, the university-based organisation behind the Abilene and Internet2 projects, the University Corporation of Advanced Internet Development (UCAID), receives considerable project funding from the federal government (Internet2) and from industry (Abilene⁴). Australia is probably the only country in which the academic and research network has been user-pays since its inception, with limited direct Government financial assistance.⁵ Working out ways to address the current shortcomings of Australia's higher education advanced information infrastructure will require careful comparison with information technology funding and legislative arrangements in other advanced economies, especially as they apply to universities and the research community.⁶

⁴ The Abilene Project is named after a railhead established in Abilene, Kansas during the 1860s. In its time the ambitious railhead of the 1800s staked a claim on what was then the frontier of the United States; the Abilene Project establishes a foothold from which to explore and develop pioneering network technology. The links of last century's railway changed the way people worked and lived. The Abilene Project will transform the work of researchers and educators into the next millennium.

⁵ The AARNet Board of Management is responsible to the AVCC for the development and implementation of relevant AARNet service policy, within the parameters set by the AVCC and CSIRO. The scope of this body includes the provision of networking services to the individual AVCC member institutions and CSIRO, managed under the auspices of the AVCC.

⁶ Numerous models exist. For example, the United Kingdom's academic and research network, JANET, is funded by the Joint Information Systems Committee (JISC) of the Higher Education Funding Councils for England (HEFCE), Scotland (SHEFC), Wales (HEFCW) and the Department of Education for Northern Ireland (DENI). JANET is managed and developed by UKERNA under a Service Level Agreement from the JISC. SuperJANET is the broadband, or high speed, part of JANET. The name was coined in 1989 for a new initiative aimed at providing an advanced optical-fibre broadband network for the higher education community at an affordable price. The SuperJANET projects (I-III) have transformed the JANET network from one primarily handling data to a network capable of simultaneously transporting video and audio as well as data. Another example is DANTE (Delivery of Advanced Network Technology to Europe Limited), a not-for-profit company established by the national research networks in Europe. Another European example, the TEN-155 network, is co-funded under a joint initiative of the ESPRIT, Telematics for Applications and ACTS Programmes of the European Commission and is a direct result of the Quantum project. CANARIE and UCAID offer other models, but all have external government funding in common over and above normal operational budgets for universities.

The demand for bandwidth within Australia will grow exponentially as new applications and more data are carried on AARNet,⁷ but unless the current pricing model changes universities will simply not be able to afford the extra bandwidth. International linkages, with new services about to remove capacity constraints, are also too expensive for the higher education sector. The impact of the recent agreement between the Australian Advanced Internet Research and Education Program (AAIREP) and Internet2 to collaborate on new technologies and communications applications⁸ will depend at least in part on the cost to the partnership of access to the new high capacity cable networks to the USA.

The recent establishment of the Australian Partnership for Advanced Computing (APAC) has provided the opportunity for unique, cooperative university facilities, i.e., high performance or advanced computers, to be used to meet the research needs of industry. However, APAC, like AARNet, will need to overcome weaknesses in the national infrastructure in order to provide researchers in some universities with access to the equipment they need to conduct their research.⁹

There is evidence that some academics are selecting which university to work for on the basis of access to infrastructure. In the longer term this could marginalise some universities, reducing their opportunities to attract quality staff and consequently affecting the standard of their teaching and research. All universities recognise the need to keep their information technology current. They are employing various technologies (such as Thin Client) to reduce costs while also maintaining up-to-date software and hardware.

Strategic Priorities

Analysis of current facilities and IT infrastructure in post-secondary vocational and higher education institutions and research organisation

In order to enable effective planning of infrastructure development, a coordinated national approach to the identification of existing and planned IT&C facilities and infrastructure in post-secondary vocational and higher education institutions and research organisation is required.

One vehicle available to the Commonwealth to achieve this is the Major Research Facilities Working Party of the Coordination Committee on Science and Technology (CCST). It is recommended that the Working Party ensures that such a survey is undertaken under its terms of reference and that the results be provided to relevant Commonwealth agencies and committees, MCEETYA, the ERC and the AVCC.

⁷ National Bandwidth Inquiry – A Submission to the Department of Communications, Information Technology and the Arts, Committee of the Australian University Director's of Information Technology, 1999 (CAUDIT).

⁸ 'Australian Universities to Connect to US Internet2,' Media Release, AVCC, 17 September 1999.

⁹ *High Performance Computing and Communications in Australia*, Higher Education Division Occasional Paper Series, 1998, p. 39ff.

New collaborative arrangements between, industry, research organisations, education and training organisation and Commonwealth and State Governments

For Australia to regain its international competitiveness in advanced information and communications infrastructure developments, collaborative initiatives between industry, educational and research institutions are necessary. Collaboration should focus on the development of new advanced networks networks (linked to existing networks) as a proving ground for new applications, services and technology.

In particular, the AVCC urges the government to emulate many of the programs funded by the US, Canadian and European governments, including those aimed at advanced infrastructure development (i.e., networks that can perform at much greater levels than today's commercial Internet), advanced applications development, and research into technologies that will enable advances in infrastructure and applications (e.g., Quebec's deployment of dark fibre to Schools project¹⁰). One such initiative could be the establishment of a non-profit, industry-led consortium, similar to CANARIE,¹¹ of private sector organisations, education, training, university and research institutions and the Commonwealth Government, to plan and accelerate the development and deployment of next generation networking technology and applications in Australia.

Advanced Computing

Many of the applications initially run on advanced computers will migrate to PCs in the future. An increase in Australia's advanced computing (or supercomputing) facilities and associated research programs is needed so that Australia receives the benefits from applications moving from advanced or high performance computers to PCs, and from being linked to cutting-edge research in other countries.

To achieve this the Australian Partnership for Advanced Computing (APAC) will need to work with the Commonwealth and State Governments to access sufficient funds to ensure its advanced facilities and research programs reach and maintain world top 10% standard.¹² DETYA has already provided \$19.5 million for the establishment of APAC, but the AVCC believes that arrangements for the funding of advanced computing should be reconsidered in order to:

¹⁰ <http://www.canarie.ca/eng/outreach/publications/news/CommSept99.pdf>

¹¹ CANARIE Inc. is Canada's advanced Internet development organisation. It was established in 1993 and has been working with government, industry, and the research and educational communities to enhance Canada's advanced Internet infrastructure, applications development and use.

¹² *High Performance Computing and Communications in Australia*, Higher Education Division Occasional Paper Series, 1998, p. 13ff, indicates that Australia has fallen well behind other developed and developing economies in recent years.

- allow for funds from both the Department of Industry, Science and Resources (DISR) and DETYA to be used to purchase hardware that will meet common but not exclusive aims of both programs,¹³ and
- make more cost-effective use of Commonwealth funds.

The AVCC believes that the quantum of funds should not be reduced. The university partners of APAC will be contributing considerable funds, equipment and human resources each year to APAC.

Growth of a world class infrastructure

Every university must be able to access and afford world-class advanced information technology, including increasing amounts of bandwidth, so that they can:

- support general and advanced research that will allow for the discovery and development of new knowledge, products and applications;
- provide access both on- and off-campus for students, researchers and industry partners to increase service and knowledge delivery both within Australia and overseas. Almost all courses offered by Australian universities use information technology, and some are almost entirely dependent on information technology both for delivery and for storage and use of existing data;
- attain the high-level international linkages that are fundamental to the maintenance of Australia's internationally competitive research capabilities and its ability to compete in the global education and research markets;
- ensure subjects and courses with few enrolments and/or higher costs of strategic importance to Australia, such as Bio-informatics, are retained and conducted through shared online resources; and
- enable information to be stored and easily retrieved for use by industry, researchers and managers.

This could be achieved by the establishment of mirror sites, improved technologies, and secure transaction environments to quickly improve access to products and services for overseas and Australian clients, and by streamlining funding arrangements for research in cooperation with industry and other research organisations to develop advanced information technology infrastructure and tools.

¹³ The Technology Diffusion Program conducted by DISR has the potential to provide funds for high-performance computing. However, in the past, DISR has been reluctant to allow the hardware purchased with program funds to be used for research, even though there is evidence that better hardware could be purchased and improved results obtained if collaboration with DETYA/ARC funding programs was allowed. This could potentially save the Commonwealth funds, allowing APAC or its members to better target applications and make more effective use of all funds.

Responsibilities

The overseas experience is that central governments play an irreplaceable role in providing financial resources, setting major policy and legislative arrangements, and securing the cooperation of industry for further developments.¹⁴

State and local governments can also play a role. In the same way that all tiers of government within Australia share responsibility for major infrastructure, such as roads, the information highway is no different in requiring public funding for the public good.

The deviation of a small proportion of government funds from other infrastructure spending to advanced information technology and communications infrastructure and project funds has the potential to boost the Australian economy and generate important new products.

Existing university and research structures (such as AARNet) can assist with the development of an advanced information infrastructure, but ultimately the policy, legislative and funding framework is in the hands of the Commonwealth Government.

¹⁴ Further examples of government support for advanced information technology and communications developments are the Next-Generation Internet, VBNS and Information Technology for the Twenty-First Century (IT²) initiatives of the US Government. IT² is a proposed \$366 million FY 2000 multiagency Federal information technology research and development initiative. The IT² initiative has three components: (1) Long term IT research; (2) Advanced computing for science, engineering, and the Nation; (3) Research on economic, social, and workforce implications of the Information Revolution. The IT² initiative will be coordinated jointly with the High Performance Computing and Communications (HPCC) programs and the Next-Generation Internet (NGI) initiative.

Online Content, Applications and Services

Context

Universities have traditionally been at the cutting edge in the application of information technology. It is therefore no surprise that universities have generated large amounts of course material online and are already using video classrooms and conferencing despite bandwidth limitations. However, to date there has been no national survey of content produced by the Australian higher education sector, nor of the range of other information technology services and applications available to and used by universities.

There is little doubt that there will be an explosion of online material (requiring greater bandwidth and improved hardware) as a result of:

- the need to deliver professional development programs in a more cost-effective, user-friendly and timely fashion than current face-to-face arrangements;
- increased use of video, sound and data-hungry graphic applications to deliver course material in real time (rather than one-off broadcasts such as radio or TV);
- increased numbers and size of web pages and data linked to educational and other sites;
- the expectations of students to have access to streaming delivery of live or recorded video and sound across the Internet, allowing any user to view such content on their local machine, wherever they may be in the world, in real time (TV or radio for the Internet if you like);
- pressures on space, teaching time and facilities such as laboratories and libraries, leading to the need to provide alternatives; and
- the participation of more mature, employed, full-time or part-time students who do not have the flexibility to attend lectures at a particular time and venue.

The latest developments in technological infrastructure provide the foundations for bringing together learning platforms and supporting information resources into an integrated national grid. This will allow economies of scale, both in terms of common core teaching and in terms of multiple distributed access to a central provider for courses with low local demand.

The challenge for our educational, research and cultural institutions is to ensure that Australia is not swamped by content from other countries with superior infrastructure and programs encouraging the development of content drawn largely from their own cultures.

Having said this, Australia is well placed in a number of areas to bring together learning platforms and supporting information resources. For example, a regional university specialising in postgraduate training in viticulture could mount the course online and develop links through the national information infrastructure to supporting materials located both in Australia and overseas.

Alternatively, a metropolitan university with high undergraduate enrolments in first-year economics could distribute online units on a contractual basis to any number of universities with the links to appropriate support materials held in the national information grid.

Higher education institutions are also using IT&C to pioneer new areas of research. Complex applications and programs are being developed and used to support cutting-edge applied and basic research. Tools to facilitate co-authoring and electronic project management of research projects are essential but slow to be implemented. Electronic networks for the rapid dissemination of research results are already of critical importance in many areas of research. Special equipment (e.g., massive data libraries, advanced computers, high-powered microscopes, and wind tunnels) can be accessed remotely if the infrastructure and applications are capable of handling the data and other requirements. New and better applications in these areas are needed to assist researchers.

Applications and services are also being developed to support business and administrative operations. Institutional administration, course management, statistical reporting, student services and libraries in nearly all universities are being overhauled, with new developments being implemented rapidly. Improved interworking of office systems, including administrative systems and multimedia communication, is possible but not being widely implemented.

In order to remain internationally competitive, IT&C will need to be taken up and applied as rapidly as possible within all Australian universities. To achieve this, in addition to issues identified elsewhere in this paper (such as infrastructure and development of IT skills by university personnel), the policy environment must encourage the uptake of IT&C in all spheres of university teaching, research and administration.

There is evidence that Australian universities are now making significant investments in educational technologies, but the level of these investments is difficult to determine. In some cases universities appear to be waiting for information technology to infiltrate their teaching. In other cases universities appear keen to adopt new modes of delivery in order to improve services to students and to save on the expensive printing and mailing costs incurred by older methods.

One issue universities are working to resolve in the online environment is that of copyright in courseware produced by staff. While universities may not be able to agree on guidelines to cover the ownership of copyright in published works,¹⁵ agreement will more likely be

¹⁵ The issue of ownership of copyright in monographs and journal articles written by university staff in the course of their employment, and the related issue of paying copyright royalties to copyright owners for the use of journal articles in teaching, is a difficult one on which to obtain consensus across the

reached on the importance of universities retaining copyright in courseware produced by staff, particularly online courseware. Guidelines for developing online courseware will necessarily be complex; the AVCC is planning to develop these.

Australia is also cooperating in the development of international standards for online content (for example, the Instructional Management System or IMS). Universities will need to keep across such trends if their courses and services are to remain internationally competitive.

Issues such as copyright, international market opportunities, opportunities for bulk acquisitions or collaborative infrastructure, establishment of standards and quality assurance must also be addressed positively. The Commonwealth Government plays a key role in all these areas.

A national strategic framework that ensures appropriate investment in technological and information infrastructure is essential in order to match students, researchers, managers, administrators and resources, irrespective of geographic location.

Strategic Priorities

EdNA Digital Database

It is proposed that EdNA develop a national digital database that:

- identifies existing curriculum and other digital resources at local, system and national level to avoid expensive duplication of human and other resources;
- demonstrates how academics in a range of subjects are applying information technology to courses, educational software and resources; and
- encourages Australian firms, associations, institutions, museums, libraries, archives, educational institutions and other organisations to digitize text, images, audio and video material and incorporate it in attractive websites for display on the World Wide Web through an EdNA Digital Collections server. As a collection, these websites would demonstrate the growing pool of skills, talent and content available to the Australian education sector and multimedia industries.

Under this proposal universities would continue to support EdNA Online as a service that provides access to quality online resources and services, developed either by individual institutions or collaboratively and managed as a distributed system that:

- registers and identifies existing resources at local, system and national level;

higher education system. It is acknowledged that, to prevent staff from being exploited by publishers, it is desirable that academics not assign their copyright to publishers without obtaining advice or guidance from the university. However, it is also acknowledged that it would be difficult to gain support from academics for such a policy, as their tenure and promotion depends on their being published in top journals.

- provides information to prospective users about how existing information can be used with relevant permission and clearances;
- provides intellectual property-rights management for materials and services developed by individual institutions; and
- establishes technical standards and protocols that support information exchange and access to content (in conjunction with the IMS initiative).

Organisational and Policy Framework

Context

The introduction of the *Telecommunications Act 1997* has affected the organisational and policy framework within which Australian higher education and research institutions operate. The legislative and regulatory framework is of such importance that it is dealt with elsewhere. However, there are other substantial policy issues relevant to the higher education sector.

The outcomes of the *Strategic Framework for the Information Economy* should provide a whole-of-government policy framework for issues involving IT&C and the education and training sector, but other policy developments may delay the resolution of key issues. Several of these are outlined below.

The proposed framework within the Government's Green Paper on higher education research¹⁶ is intended to benefit all parties participating in the generation and application of research, and the implications for IT&C should be considered. The paper states that:

It is ... the legitimate and necessary role of Government policy to ensure that there is an environment conducive both to excellence in research and to the application of research outcomes in the wider national interest. This goes partly to the Government's role as funder, in providing the resources needed for high-quality research which meets 'national benefit' or 'public interest' criteria. It goes also to the Government's role in promoting public awareness and understanding of the importance of research to Australia, and in informing public debate on scientific or research-related issues of community interest or concern. Not least, it goes to the structure of incentives within the public policy framework; to the design and structure of funding programmes; to the promotion of excellence, including through competition; and to the encouragement of a national culture of enterprise and innovation.¹⁷

The Green Paper proposes reforms that are designed to encourage universities "to pursue a more integrated, systematic and strategic approach to planning their overall research efforts ... to forge more effective links both within their own institutions and with other institutions and industry; to better relate their strategies for the conduct of research and for the delivery of research training."¹⁸ The ramifications for the Research Infrastructure Block Grant Scheme and the proposed Linkage Element are unclear.¹⁹

¹⁶ *New Knowledge, New Opportunities: A Discussion Paper on Higher Education Research and Research Training*. The Hon. Dr David Kemp MP, Minister for Education, Training and Youth Affairs, June 1999

¹⁷ *Ibid.*, Section 3.18.

¹⁸ *Ibid.*, Section 3.10.

¹⁹ *Ibid.*, Section 7.23, states that the "funding available under the RIBG programme will be transferred to granting agencies with the expectation that those infrastructure overheads formerly funded through RIBG will be covered by grants." In Section 7.4 the paper also says "the Linkage element will provide support for the development of research ventures involving national and international collaboration between institutions and/or collaboration between institutions and other parties, such as industry

The National Bandwidth Inquiry will also have an impact on IT&C in higher education. The Inquiry's work is intended primarily to provide an authoritative analysis of issues relating to the current and future capabilities of the Australian telecommunications network to deliver adequate infrastructure support for a full information economy. The major area of focus should be the 'backbone' telecommunications data networks and links within Australia, and between Australia and other countries ('the trunk network').²⁰

The recently announced review of the nation's science base, including funding mechanisms, characteristics to support leading-edge industry research, and the contribution it can make to economic development, will also have a significant impact. The review has implications for universities, as DETYA is the largest single funding provider for science in Australia. AARNet also provides some of the IT&C infrastructure needs of several non-university research organisations, and changes to funding mechanisms may affect AARNet, Cooperative Research Centres, the CSIRO, ANSTO and other research organisations with the need for access to advanced IT&C infrastructure.

Within the Commonwealth Government there already exist potentially powerful policy and program coordination mechanisms for addressing key policy and funding issues. Prominent among these are:

- the Australian Information Economy Advisory Council (AIEAC);²¹
- the Online Council (OC);²²
- the Ministerial Council for the Information Economy (MCIE);²³
- the Coordination Committee on Science and Technology (CCST); and
- the Prime Minister's Science, Engineering and Innovation Council (PMSEIC).

The Coordination Committee on Science and Technology (CCST) complements the work of the Prime Minister's Science, Engineering and Innovation Council (PMSEIC). It provides input, where appropriate, to the meetings of PMSEIC or its Standing Committee, to advise

partners and the CSIRO. Funding will primarily be of a seeding nature. The programme will also support strategic investment in the collaborative use of infrastructure."

²⁰ 'National Bandwidth Inquiry—Terms of Reference,' Media Release, Senator Richard Alston, 9 December 1998.

²¹ The Australian Information Economy Advisory Council (AIEAC) is a new advisory group created to provide high level industry and community input to Government decision making on information industries and information economy issues.

²² The Online Council (OC) is a Commonwealth, State and Territory ministerial body created to address a wide range of issues affecting the development of the information economy and to promote consistency in the use of information and communication services in government. The Council is chaired by Senator Alston, and includes senior ministers from State and Territory governments and a representative from the Australian Local Government Association (ALGA).

²³ The Ministerial Council for the Information Economy (MCIE) is a high-level Commonwealth body established by the Prime Minister to coordinate a whole-of-government action agenda for Australia's participation in the information economy.

on matters of concern that may require a whole-of-government response.²⁴ Currently the Committee has two working parties:

- The Major Research Facilities Working Group set up in July 1998 to report on the prioritisation and coordination of funding for Australian access to major research facilities. The Working Group has representatives from ISR (Chair), ARC, NHMRC, AGSO, CSIRO and ANSTO.
- The CCST University-Industry Interaction Working Group established in late June 1998 to consider the wider aspects of university-industry linkages.²⁵

Both of these Working Groups have reported to the CCST. The recommendations of the Major Research Facilities Working Group are to be referred to the Chief Scientist's Review of the Science Base. The Final Report of the University-Industry Interaction Working Group has been referred for consideration at the National Innovation Summit, to be held in February 2000.

Non-Commonwealth Government organisations have also been developing policy options. In the higher education sector, the AVCC issued a discussion paper in 1996 that explored, along with other issues, the need for "A Vision of Education".²⁶ The paper noted that:

a richly interconnected and highly leveraged network of computing resources, tools and information resources that provide students and teaching staff with unprecedented access across disciplinary, institutional and national boundaries is emerging through the use of the information technologies. The evolving national and international network infrastructure allows access by students and teachers to each other and to alternate centres of expertise. The implications for education could be enormous. Some commentators see the impact of IT on education being as important a watershed as the invention of writing or the printing press. We now appear to be entering the Information Age which is characterised by the electronic transmission of information.

The paper also remarked on the need for a shared vision of what education and training should be in the 21st century. It noted that, unlike other countries, Australia does not have a central coordinating and funding body specifically for IT in higher education. It argued that "serious consideration needs to be given at the highest level to establishing a coordinating and funding body under the joint auspices of DEETYA and the AVCC to coordinate all national activities and initiatives in the sector". The paper went on to suggest that such a body might have responsibility for development of national policies on the application of telecommunications technologies, expansion of networks (to K-12 schools, TAFE, etc.), and the establishment of software and communications standards.

Although such a body has not materialised, the level of discussion regarding IT&C infrastructure between the higher education sector and the various levels of government has

²⁴ Details of the Terms of Reference and membership of CCST can be found at <http://www.science.gov.au/ccst/>

²⁵ Terms of Reference for CCST Major Research Facilities Working Group can be found at <http://www.science.gov.au/ccst/mrf.html> and University-Industry Interaction Working Group Terms of Reference at <http://www.science.gov.au/ccst/univ.html>

²⁶ *Exploiting Information Technology in Higher Education: An Issue Paper*, AVCC, October 1996.

improved over the last two years, particularly through preparation of the Expert Group Report for the development of APAC²⁷ and the establishment of the Higher Education Information Technology Consultative Forum (HEITCF). The EdNA Reference Committee has also been established by Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) in part to provide advice to Ministers on major policy issues associated with the use of computer networks in the delivery of education in Australia. Because of the genesis of EdNA as an education directory service, this function is still being developed, and relies on the input of committee members who are frequently extremely busy and have only minimal support infrastructure. Considerably more work has to be done, and perhaps some expert consultancies or policy papers have to be undertaken, to make the ERC and MCEETYA more effective as policy forums.

An alternative forum to MCEETYA may be required, as sought by the AVCC in its paper. In this context, a valuable role could be played by the National Scholarly Communications Forum (NSCF), formed in October 1993 by a group of organisations concerned to ensure that Australia obtains maximum benefits in the rapid transition to forms of electronic communications for publishing, libraries, education and the business of government.

The NSCF is sponsored by Australia's four learned Academies: the Academy of the Social Sciences in Australia, the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, and the Australian Academy of the Humanities. Its membership comes from a wide range of bodies representing academics, independent researchers, writers, librarians, publishers, together with specialists in copyright and in the new digital technologies.

The aim of the NSCF is to disseminate information about changes to the context and structures of scholarly communication in Australia and to make recommendations on what a broad spectrum of participants see as the best developmental policies. To this end, it organises a series of Round Tables where relevant issues are debated, future strategies are proposed and outcomes are recorded through a variety of forms of publications.

Strategic Priorities

Planning, development and implementation of new infrastructure

It is recommended that the ERC commission a report on options for, and obstacles to, the development of shared infrastructure by schools, TAFE, universities and other non-profit organisations with a view to exploring superior Internet services to regional areas and organisations.

²⁷ *High Performance Computing and Communications in Australia*, Higher Education Division Occasional Paper Series, 1998

It is also recommended that a concurrent report be prepared for the ERC on options for the development of fibre networks, which could service the education and training sector more cost-effectively than current arrangements.

To facilitate both reports, the AVCC would be prepared on behalf of the ERC to convene a working party of technical and legislative experts from within universities, the VET sector and schools to prepare a framework for the reports and select suitable people to prepare them.

Review of Commonwealth funding programs

The AVCC recommends that the Commonwealth government revise existing programs involving funding to universities and industry to ensure that they are complimentary and to encourage effective synergies between them: for example, REIF, the Technology Diffusion Program and the Testing and Conformance Infrastructure Initiative.

Regulatory Framework

Context

The *Telecommunications Act 1997* introduced a new era for the organisational and policy framework within which Australian higher education and research institutions had to operate.²⁸ It has been argued by the Commonwealth Government that the benefits to Australian businesses and consumers of the post-July 1997 regulatory changes are now clearly measurable, with expanded investment and employment in the telecommunications sector; greater choice of telecommunications services; greater responsiveness to the needs of customers; improved quality of service; and lower prices for telephone calls (especially long-distance calls).

However, the experience of higher education institutions has been that of increased costs, unwillingness by carriers to explore new technologies in cooperation with research institutions and universities, and reduced options for cooperating with industry, other parts of the education and training sector, and non-profit organisations.

Under the Act, special exemptions from legislative obligations were given to eligible tertiary education institutions by Ministerial Determination. As AARNet is a private network, the AVCC has a written access policy based on current legislation and the Ministerial Determinations: AVCC Members may use AARNet for or in connection with their research, educational or administrative functions. The existence of these Determinations demonstrates if nothing else that the Commonwealth Government has a crucial role to play in the development of policy and organisational frameworks for the establishment of the infrastructure that influences the uptake of flexible learning opportunities.²⁹

Legislation in other countries has taken a different approach, with strong incentives from both federal and state governments for the education and training sector to maximise use of the Internet and other new applications: for example, the development of CANARIE in Canada and various programs in the USA that make connectivity cheaper and easier to arrange for schools, libraries, hospitals and educational institutions.

²⁸ *Bandwidth Requirements for the Australian Education and Training Sector*, Australian Commonwealth Department of Education, Training and Youth Affairs, August 1999, pp. 11-12.

²⁹ The Determinations in regard to eligible tertiary education institutions cease to have effect on 31 December 1999 or on such later date as is determined by the Minister. The explanatory notes to the legislation state that:

The 'sunset' clause(s) will enable the operation of the exemption to be reviewed after some period of operation, following which its continued operation (either as drafted or in a revised form) can be considered by the Minister. It is expected that, depending on the outcome of such a review, options before the Minister may include letting the exemption lapse, enabling the exemption to continue for a further specified period, and enabling the exemption to continue either in a widened or more narrow form. The Minister may also consider whether the definition of tertiary education institution is appropriate.

The AVCC believes the existing Ministerial Determinations make it very difficult for universities, TAFE, schools and other government and non-government (not-for-profit) organisations to share communications infrastructure, even where this would reduce overall demand for funding on State and Commonwealth Governments. In addition, current arrangements make interaction with business and industry through shared infrastructure costly and difficult. Whereas university staff and students and officers of the CSIRO are permitted direct access to AARNet and therefore to each other, the organisations outlined above are not allowed to use AARNet even if they share the same geographical location.

For higher education and research institutions outside the limited AARNet network, especially in regional centres, opportunities for accessing suitable IT&C infrastructure are limited. Carrier charges are frequently more than higher education institutions can afford, and they are unable to cooperate for the establishment of regional facilities with other institutions, such as TAFE, hospitals and State and Commonwealth Government agencies and departments, because of current legislative requirements.

Government funding programs and policies are frequently counter-productive, as they artificially segment research from industry development and assistance. Universities are obliged to establish expensive separate IT&C facilities and networking arrangements when the same infrastructure could effectively serve research and industry development needs.

With many advanced IT&C systems and facilities being connected to AARNet, and AARNet in turn being connected to the Australian and global Internet, organisations without direct access to AARNet could access advanced IT&C facilities and systems via their respective Internet service providers. However, while this method of connection would probably be adequate to access basic facilities, connections with the dedicated and sufficient bandwidth and other quality-service parameters required for some applications are less likely, at least in the short-term. (These issues are canvassed at length in *National Bandwidth Inquiry – A Submission to the Department of Communications, Information Technology and the Arts.*)

The constraints placed upon the education and training sector under current legislative arrangements will in the longer term be detrimental both economically and technically to Australian education, research, training and industry. Australia will be unable to compete with countries such as Canada and the United States because carrier charges will be too high both within Australia and between Australia and overseas research partners.

Another impediment to the information economy is the proposed arrangements for copyright under the Copyright Amendment (Digital Agenda) Bill, introduced into Parliament in September 1999. This Bill was referred to the House of Representatives Standing Committee on Legal and Constitutional Affairs, which is currently considering submissions from both copyright owners (representatives of authors, publishers, broadcasters, etc.) and copyright users (schools, universities, libraries, information technology managers and consumer groups).

The proposed legislation was welcomed by the university sector as providing the opportunity to specifically address and clarify the basis upon which educational institutions can make use of copyright material in electronic form. The capacity to leverage off existing investment in information technology in support of education and research in Australia is essential in maintaining the sector as a major export industry (currently Australia's eighth largest). Access to information and the exemptions for fair dealing underpin an information-rich education and research environment, without which Australia will limit its capacity to be an innovative "clever country" in the digital age.

The Exposure Draft released earlier this year outlined a copyright regime that would, if implemented in legislation, maintain the appropriate balance between the rights of copyright owners and users. A number of the changes put forward by the university sector, to better protect the rights of access to and use of materials in both hard copy and digital form by staff and students, have been adopted in the Bill. However, the most recent version of the legislation contains provisions of deep concern to universities. These changes no longer maintain the balance between the rights of copyright owners and users. If implemented, they will suit copyright owners and large commercial interests in the United States and Europe, but disadvantage Australia, particularly the education and training sector. Considerable additional costs will be incurred by schools, vocational education institutions and universities.

In a related area, the AVCC has also raised concerns about the jurisdiction and procedures of the Copyright Tribunal, an inquiry into which is currently being conducted by the Copyright Law Review Committee (CLRC). The AVCC has brought a number of concerns to the attention of the CLRC.

Another piece of Commonwealth legislation, the *Broadcasting Services Amendment (Online Services) Act 1999*, may also have a profound impact on universities. The aim of the Act is to protect children from illegal and highly offensive material online. The difficulty for universities is that some students and other users of their library resources are under 18, and preventing access to prohibited material from public terminals may place unreasonable demands on the technical and administrative systems of universities. The implications of the Act are yet to be assessed by universities, and will depend in part on the procedures put into place by the Australian Broadcasting Authority to implement the legislation.

Strategic Priorities

Reconsideration of the legislative and regulatory framework for telecommunications

The Higher Education sector recommends that the Commonwealth urgently reconsider the telecommunications legislative and regulatory framework, so that Australia's information technology infrastructure:

- meets the current and emerging needs of universities, industry collaborators, other major research institutions such as ANST, DSTO and the CSIRO; and

- can enable affordable access to universities by students, industry and researchers from all parts of Australia and from overseas.

The regulatory framework should also support and not impede the needs of Australia's education and training industry. In a knowledge-based society, intellectual property is currency.

Amendments to proposed copyright legislation

The Copyright Amendment (Digital Agenda) Bill should incorporate further provisions that are critical to the ability of university, TAFE and school students and staff to continue to exercise rights of access, reading and fair dealing in the way that the government intends. Failure to include such provisions will result in a significant and seemingly inadvertent change to the balance between the interests of copyright owners and users. Support from DETYA and other Commonwealth agencies is urgently required.

Following the passing of the Bill into law, consideration will also be given by the AVCC to the preparation and circulation of guidelines for universities to follow in developing their intellectual property policies, particularly in relation to university ownership of copyright in courseware and online courseware.

Implementation of the Broadcasting Services Amendment (Online Services) Act

Universities will need to assess the impact of the above Act on their technical and administrative systems over the next few months as the legislation takes effect from 1 January 2000.

Responsibility

The responsibility for achieving a workable national legal and regulatory framework does not lie with one agency or stakeholder alone.

Universities, research organisations, the VET sector, industry and schools must give easily understood examples of how changes to current policy and legislative arrangements would benefit the Australian economy, and of how existing policies are hurting them and the economy, to enable State and Commonwealth Governments to plan positive, effective change.

This project was funded by the Department of Education, Training and Youth Affairs.

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