Australian Computer Society

Submission to the Review of Higher Education Financing and Policy

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Executive summary

The Australian Computer Society (ACS) welcomes the opportunity to make a submission to the review of Higher Education Financing and Policy. The submission concentrates on specific elements of the Review terms of reference and issues canvassed in Learning for Life, the discussion paper issued by the Review, namely:

- the issue of a universal student entitlement (including average provision of basic computing equipment to support study);
- the need to provide incentives to maximise the supply of IT&T graduates to service the IT&T industry and act as technology enablers in an increasingly broad range of industries;
- the role of the professional and industry leadership in the accreditation of university level IT&T programs;
- the need for targeted development of teaching skills and use of IT&T for teaching delivery; and
- better use of capital funding to encourage institutional (and cross institutional) investment in technology in a way that best positions Australian universities domestically and in the international education market.

In preparing this submission the Australian Computer Society believes that several key issues must be considered by the HERF&P. These are:

- information technology and telecommunications will profoundly alter social interaction, work and education over the next 20 years;
- universities will be critical agents in the production of the skills required to operate in the knowledge society. The role of universities in explicit vocational preparation at the professional level must be affirmed;
- universities should maximise their links with the IT&T industry, the profession and professional bodies to ensure that all graduates are adequately prepared for the IT&T futures, and that IT&T graduates in particular develop the requisite knowledge and skills;
- co-operative R&D activity in IT&T between universities and the IT&T industry will make a significant contribution to national innovation and competitiveness. Incentives to pursue this must be found;

  a number of interrelated social and economic changes are occurring simultaneously (more heterogenous student body, mass higher education, competition and reducing government funding). Together, these combine to transform the nature of higher education as it has been understood to this

point in time. IT&T has emerged along side these as a change agent, capable of enabling transformations of how work is conducted, including the educational enterprise;

- the impact of IT&T will affect the operations of universities as well and a greater level of strategic action is required to embrace the change. IT&T holds the potential to increase the relevance of the predominant teaching paradigm to future generations as well as provide benefits to the universities and the Australian economy;

- greater cross institutional co-operative effort is required to maximise IT&T investment, purchasing power, support the local industry and provide a sufficient market for content development.

Finally, the ACS has a number of recommendations on specific issues that we believe the Review team need to address as they prepare their final advice to Government.

1. *The ACS recommends that in expanding this concept the RFHE ensure that any resourcing model be designed to:*

   · *the objectives of the university system must include support for vocational preparation of IT&T professionals;*

   · *learning for life must translate to ongoing provision of development of IT&T professionals post initial qualifcation both through formal post graduate programs and in shorter, targeted industry refresher programs;*

   · *the public benefit arising from the provision of a highly skilled workforce based on university level preparation in an increasingly global, competitive and knowledge driven industries provides a strong case for expanding public investment in higher education.*

2. *The ACS recommends that in expanding this concept of the RFHE ensure that any resourcing model be designed to:*

   · *encourage research and development of teaching practice using IT&T*

   · *the approach to capital funding be weighted to encouraging collaborative investment in IT&T to support the delivery of educational services both domestically and internationally.*

3. *The ACS endorses the suggestion that key IT&T industry bodies together with the profession provide independent accreditation for IT&T related courses and courses with a significant IT component. The ACS (the profession) already accredits the main university based IT courses. In addition, the ACS has a fully developed core body of knowledge and proven framework for assessing curriculum and the suitability of universities to deliver IT&T programs. One of the purpose of the core body of knowledge is to enable professional accreditation in other disciplines if there is a significant IT*

component in the educational preparation. The ACS is then able to provide an endorsement to the professional status of individuals graduating in these disciplines.

4. *The ACS recommends that funding for IT&T related courses be weighted to provide a positive incentive to enrolling students. Funding should be at a level to enable providing institutions in maintaining an appropriate level of technology to produce up to date and highly skilled graduates who will support the implementation, maintenance, research and development in IT&T applications across all industries.*

5. *The ACS recommends that the entitlement to post secondary study for all Australians must be structured to allow 'cashing in' for both full-time undergraduate or post graduate study and post graduation professional development.*

6. *The ACS recommends that:*

   · *traditional terms and conditions be re-examined to ensure that academic staff focus on excellence in teaching and the expanded interaction with students made possible by advances in telecommunications; and*

   · *in light of changed expectations of student interaction and the teaching paradigm academic salaries be aligned to relevant industry benchmarks.*

7. *The ACS recommends:*

   · *co-operative development of an IT&T strategy for the Australian university system between the AV-CC, DEETYA, the profession, and the local industry;*

   · *allocation of IT&T investment funding to support co-operative investments in common hardware, software and content delivery;*

   · *capital funding to universities should be structured to provide appropriate incentives to invest in IT&T infrastructure for enhanced delivery;*

   · *priority be given to research grants that involve collaborative use and reuse of technology and existing practice in technology based education delivery.*

8. *The ACS recommends that the student "entitlement" should be structured at a level to allow all students to purchase appropriate computing equipment and software. Co-operative purchasing arrangements, either by the individual universities or the Commonwealth Government should be investigated to enable significant cost reductions through bulk purchasing arrangements for computer hardware and telecommunications tariffs on behalf of students. The purchase of a basic level of computing equipment should be a prerequisite for every course.*

9. *In addition, the ACS recommends that the resources made available at the institutional level through student self-provision with computing equipment be tagged for reinvestment in supporting infrastructure (particularly electronic networking) by universities.*

The education industry is one of the industries in the economy least transformed by technology, yet it is required to produce people with the skills and competencies necessary to become workers and citizens in the information society[11].

Investment in, and promotion of, high quality education and training is one of the most important contributions that can be made to Australia's future. The availability of skilled workers is a key to attracting investment, advancing the take up of new technology, undertaking innovation and creating sustainable economic advantage. In the information industries more than most other sectors of the Australian economy, the core competitive advantage rests in the skills of the people. And this is becoming increasingly true of information and communication technology user industries too[2].

[1] Tinkler, D., Lepani, B. And J. Mitchell (1996) *Education and technology convergence: a survey of technological infrastructure in education and the professional development and support of educators and trainers in information and communication technologies.* NBEET Commissioned Report No. 43, Canberra, AGPS, p. 93.

[2] The Information Industries Taskforce (1997) *The global information economy: the way ahead* Canberra, AGPS.

1 Introduction

1.1 Background

In 1997 the Federal Government established the Review of the Higher Education Financing and Policy (HERF&P) to:

- undertake a broad ranging review of the state of Australia's higher education sector, the effectiveness of the sector in meeting Australia's social economic, scientific and cultural needs, and the developments which are likely to shape the provision of higher education in the next two decades;
- develop a comprehensive policy framework for higher education that will allow universities to respond creatively and flexibly to change, and will ensure that the sector meets the needs of students, industry and society in general as these are likely to develop over the next two decades;
- identify options for financing higher education teaching and research, and for providing Commonwealth funding to higher education institutions for these purposes.

Amongst a range of other items for consideration of long term developments the committee has been asked to examine the level of industry demand for higher education graduates, the contribution of university research to the competitiveness of Australian industry, and use of advanced communications technologies in teaching, in libraries and other teaching and research infrastructure.

1.2 Learning for life

In November 1997 the HERF&P published a discussion paper, Learning for Life, that outlines the general direction of the thinking amongst the committee. This discussion paper specifically requests additional input from interested parties in the following areas:

- universal, publicly funded access to post-secondary education;
- a life time entitlement to post secondary education, equivalent to approximately five years full time study;
- flexibility in the charging of tuition fees;
- the differentiation of access to publicly subsidised post-secondary education by course;
- implementation of consumer protection mechanisms - more robust accreditation, institutional financial viability assurance, and comprehensive and independent information for prospective students;
- incentives for better asset management, including greater flexibility in the disposal and acquisition of assets;
- more emphasis on high quality teaching in universities;

- implementing a research training resource allocation system based on portable scholarships;
- implementation of a research funding approach that is strategic, targeted, competitive and focused on knowledge, technology and skills transfer to the broader community.

1.3 Focus of our submission

The terms of reference for the review are broad ranging and the Learning for Life discussion paper raises many issues. In preparing this response the Australian Computer Society has selected a few key points to comment upon. The following submission focuses primarily on:

- the issue of a universal student entitlement (including average provision of basic computing equipment to support study);
- the need to provide incentives to maximise the supply of IT&T graduates to service the IT&T industry and act as technology enablers in an increasingly broad range of industries;
- the role of the profession and industry leadership in the accreditation of university level IT&T programs;
- the need for targeted development of teaching skills and use of IT&T for teaching delivery; and
- better use of capital funding to encourage institutional (and cross institutional) investment in technology in a way that best positions Australian universities domestically and in the international education market.

1.4 The Australian Computer Society

The Australian Computer Society is the professional association for information technology (IT) professionals, attracting a large and active membership from all levels of the IT industry, and providing a wide range of services to its membership. It is the public voice of the IT profession, the guardian of professional ethics and standards in the IT industry, with a commitment to the wider community to ensure the beneficial use of IT.

The ACS has been closely involved in many facets of IT education. The Society recently joined forces with PAGE, a recognised provider of external Professional and Graduate Education, and the AIIA, to offer a new program in IT management. The new courses, to be delivered on-line from February 1998, are tailored to meet the specific needs of the Australian IT industry.

Further, the ACS has, since 1993, being conducting its own Certification Program, an industry-based masters degree level course of study consisting of four one-semester modules.

It is delivered by distance education and can be completed part-time within two years.

The ACS Certification Program provides a post-graduate (masters degree level) program to IT professionals in Australia, New Zealand and other Asia-Pacific countries.

The ACS has developed a Practising Computer Professional (PCP) scheme as a means of ensuring that all members have the opportunity and the incentive to update their skills and knowledge as IT professionals. Attendance at different seminars, conferences and other like activities, over a variety of IT topics, enable members to "qualify" as a PCP.

The ACS has a fully developed accreditation system for IT courses being taught in Australian universities. In this way both the profession and industry have input to the courses being taught.

The mission of the Australian computer society is:

to advance professional excellence in information technology

and its objects are:

- to further the study, science and application of information technology
- to promote, develop and monitor competence in the practice of information technology to persons and organisations
- to maintain an promote the observance of a code of ethics for members of the Society
- to define and promote the maintenance of standards of knowledge of information technology for members
- to promote the formulation of effective policies on information technology and related matters
- to extend the knowledge and understanding of information technology in the community
- to promote the benefits of employing members of the Society.

2 Globalisation of industry and education

The concept of the global economy is ubiquitous. Few, if any nations are immune to the impact of events at a global level, particularly as they relate to economic stability and development. Underpinning the development of the global market place lies IT&T. It is this critical enabling technology that makes the difference in global trading and interaction today, compared to global trading of 100, 50 or even 20 years ago. Information and trading is real time and location is no longer a defining characteristic. Not only has IT&T transformed our capacity to carry out business transactions, it has also transformed how business and industry operate - from the most highly sophisticated manufacturing technologies, to research and development, to the growth of the services sector (including education).

2.1 Significance of the information industries in Australia

The recent Information Industries Taskforce report (1997) highlighted the size, impact and strategic importance of the information industries for Australia:

- Australian market revenues of approximately $67B in 1995 - includes electronics, IT&T platforms and peripherals, telecoms carriage and services, IT services and information and entertainment services
- exports exceeded $4B in 1995, placing the industry amongst the leading exporters;
- a significant creator of jobs - approximately 500,000 Australians are employed in or spend a substantial part of their time engaged in, the commercial activities of the information industry.

However, Australia also has a significant trade deficit in computer and communications hardware, software and services, and advanced technology equipment and systems that have integrated IT components (hidden IT deficit). The hidden IT deficit is estimated to have been between $5.2 and $10.4B in 1993-94[32].

To ensure its place in the global economy, to provide for social and economic well being and employment of its population Government and industry in Australia must work collectively to develop a sustainable IT&T infrastructure. This infrastructure includes:

- skilled people to work in the IT&T industry;
- investment (public and private) in developing the industry;
- support of research and development.

The Australian university system has an important role to play in making an input to all elements of this infrastructure.

[3] Australian Computer Society (1997) Submission to the Information Industries Taskforce

2.2 Internationalisation of education

IT&T has been particularly critical in supporting the internationalisation of education. The development of the Internet technologies has potentially opened the world market of education to any person with access to a computer, modem and telecommunications network.

Internationalisation of the university sector has apparently substituted the concept of the "great" university attracting inbound students for one where the university that sees itself as operating in an international arena for staff, students and comparisons of performance. Geographic location is less the defining characteristic of the international university that the reputation of its faculty, the mobility of its resources and student populations and the benchmarks it sets itself.

Learning and research are no longer location constrained, with digitisation of many of the great research collection and current publishing technologies. Virtual universities made up of a dispersed faculty and student body and no more capital infrastructure than is embodied in IT&T equipment and networks are already here. Even traditional sandstone, redbrick or ivy league universities are beginning to sell their wares on the Internet.

These developments pose a very real threat to a major domestic and export industry - for not only can the 'high prestige' international universities lure away from Australia inbound students from the South-East Asian region, these universities can also attract enrolments from many domestic students. While research indicates that for the younger undergraduate the campus based immersion in higher education plays an important role in transition from adolescence and provides an appropriate learning environment, the reality is that these young post-year 12 students are a declining proportion of university enrolments. Older enrollers (both undergraduate and postgraduate), who will seek other benefits than campus life, such as flexibility of study modes, ease of access to faculty and library facilities allowed by electronic communications, and market standing of the qualification, constitute a growing proportion of the student body.

The development of the university system in Australia over the next 20 years must be framed to

- complement the impact of IT&T on the economic and social way of life of this country;
- to ensure that Australian universities provide a suitably skilled supply of graduates able to work in the information age;
- to provide the university system with the appropriate IT&T infrastructure to compete for students and faculty both domestically and internationally.

The constraints to maximising this contribution include:

- small size of domestic market and of individual universities supplying to that market provides a limited base for the investment in IT&T infrastructure and courseware;

- insufficient incentives to collaboration amongst universities to develop shared
- IT&T infrastructure;

- limited large scale testing of the application of IT&T to teaching;

- limited investment in developing the skills of university staff (teaching and support) to exploit the potential of delivering educational services using IT&T;

- an approach to public funding of higher education that encourages traditional learning and research paradigms.

3 The IT&T work force

3.1 Contribution

The IT&T industry is a major contributor to employment and economic growth in Australia and:

- represent approximately 7.5% of total economy-wide revenues (larger than TCF and food, beverage and tobacco manufacturing combined;
- as a major producer of elaborately transformed manufactures;
- is experiencing compound average growth rate in turnover and employment between 1989-96 of 11.6% and 11.1% respectively;
- the domestic information industry is growing at 13% per annum (nearly four times GDP growth); and
- provides the information infrastructure critical to growth in many other industries.[4]

3.2 Employment potential

Official figures for the level of employment in IT&T related activities vary markedly.

The recent Information Industries Taskforce (1997) estimates that approximately 500,000 Australians are engaged in the commercial activities of the information industry - half in the production and maintenance of products and services and half in distribution, advertising and direct marketing.

Of this number, over 79,400 are likely to be defined as "computer professionals" (1993 - 94 figures) by the Australian Bureau of Statistics - or 16%. It can be expected that the demand for computing professionals will nearly double to reach 147,900 by 2004/05, which compares with the projected change in total employment across all industries of under 30%.[5]

Whatever the number of persons employed, all analysis points to a significant growth in employment in IT&T industries in both the current environment and projections into the future. This employment will require a range of formally developed IT&T skills.

Employment prospects are highest for those entering or in:

- rapidly growing service sectors;
- skilled professionals required for export or import competing industries;

[4] Information Industries Taskforce (1997) pp 9-12.
[5] DEET (1995) *Australia's Workforce 2005: Jobs in the future,* Canberra, AGPS

- industries where the introduction of new technologies is required to increase the value of products and services and better meet consumer needs.

These are all characteristics of the IT&T industries. Demand for higher levels of productivity from technological investments across business and industry than has occurred in the past will also increase demand for workers with IT&T skills. The university preparation of IT&T professionals must account for the demand for these skills not just from the IT&T industry but also in the increasing range of industries applying complex technology to the production and delivery of goods and services.

3.3 Supply of IT&T professionals

The university sector is a growing supplier of IT or computing professionals as Table 3.1 and 3.2 indicate. Essentially, these graduates may take one of three related employment paths as an outcome of formal study in IT&T:

- working within the IT&T "core" industry;
- working in a broader “information” industry; and
- applying their specialised IT&T skills in other industries, such as manufacturing, banking, etc.

Table 3.1 - University enrolments in information technology/systems and computing courses, 1990 and 1996

Type of course	1990	1996	% change
Sub-degree	1443	781	-45.9
Undergraduate	11,257	17,448	+55
Graduate Cert/Dip.	2845	2876	+1
Masters prelim.	176	47	-73.3
Masters	460	1875	307.6
PhD	153	617	303.3
Other	5	56	1020
TOTAL	16,339	23,700	45

Source DEETYA

Table 3.2 - Graduates in IT&T related studies

Number of graduates	1988	1989	1990	1991	1992	CAGR 1988 - 1992 %
Electrical/electronic engineering	1,311	1,348	1,373	1,604	1,727	7.1
computer science/information systems	1,888	2,127	2,521	3,187	3,548	17.1
total all courses (in all disciplines)	86,859	90,482	94,621	107,561	120,583	8.5

Source: BIE (1994)

Despite significant increases in intakes at the undergraduate and post graduate levels between 1990 and 1996 and a near doubling of IT&T related graduates between 1985 and 1992, the supply of IT&T professionals from the university sector is apparently small, even though IT&T graduates achieve above average absorption into the labour market, as Table 3.3 shows.

Table 3.3 - Destination of IT&T graduates, 1992

	working full-time	working part-time	Not working	Studying full-time	Work, study, other overseas	Total
Electrical and electronic engineering	48.0	5.4	14.3	17.3	15.0	100
Computer science	47.2	7.7	15.3	20.3	9.6	100
all graduates (all disciplines)	44.1	14.4	11.3	24.5	5.6	100

Source: BIE (1994)

The growth of the IT&T industry in its own right and the contribution of IT&T to the broader business and industrial fabric of Australia demands a reliable supply of IT&T graduates. The DEETYA predicts a near doubling of employment of "computing professionals" alone between 1993 and 2005[6] . It is important that universities are encouraged to allocate resourcing priorities to meet this demand. In developing advice on the financing and policy framework for universities over the next 20 years the HERF&P must pursue outcomes that do not provide disincentives to people wishing to enrol in IT&T programs of study.

[6] DEET(1995) *Australia's Workforce 2005: Jobs in the future,* Canberra, AGPS.

The ACS supports the HERF&P position on an entitlement to five years of funded post secondary study. This entitlement must be structured to allow "cashing in" at both undergraduate and post graduate level. It should be available to all persons enrolling in programs recognised within the IT&T industry and across the different educational sectors.

The ACS recognises that all graduates regardless of discipline carry with them attributes that will enhance employment in many industries. Indeed the applicability across occupational areas of the explicitly vocational IT&T skills of computing graduates is recognised. However, it is also arguable that IT&T skills are critical to the competitiveness of Australian business and industry and funding for enrolments in such courses should be weighted accordingly to provide sufficient incentives to people to choose IT&T as a course of study. The higher weighting will also reflect the need for continual investment in evolving technologies to ensure state-of-the-art graduates.

The ACS recommends that any funding formula for IT&T related courses be weighted to provide a positive incentive to enrolling students. Funding should be at a level to enable institutions providing IT&T courses to maintain an appropriate level of technology to produce up to date and highly skilled graduates who will support the implementation, maintenance, research and development in IT&T applications across all industries.

3.4 Professional certification and skills recognition

External accreditation and professional certification are critical and sensitive issues for any profession and universities alike. The ACS already works closely with many universities in providing external recognition of IT courses. The ACS has the expertise and industry credibility to continue this role for the IT&T industry. The ACS is concerned that universities provide suitably skilled graduates for the industry as well as:

- providing a formal assessment/certification mechanism for those many workers in the IT&T industry who do not hold graduate qualifications; and

- encouraging the development of ongoing professional development programs for delivering by the industry or university to ensure that our IT&T professionals are up to date.

3.4.1 On-the-job skills formation

The IT&T industry has in the past primarily relied upon the development of specific skills (with the exception of engineering graduates) within employment in the industry itself. This has been because the university sector was slow initially to develop appropriate courses for entry level IT professionals or supportive post graduate qualifications. To a certain extent this is being rectified. However, the imperfect diffusion of technology and the less than impressive productivity improvements derived from technological investment arguably is related to the limited supply of graduates with highly developed specialist expertise in a wide range of IT&T areas, and insufficient attention to the development of general IT&T competence for all university graduates.
While on-the job learning of IT&T knowledge and application is an important element of the development of IT&T professionals it is a risky approach to knowledge development if it is the

primary mechanism. Some form of certification program along the lines of that already developed by the ACS needs to be further enhanced in collaboration with universities and the IT&T industry. As a nation we do not allow our physical infrastructure to be developed and managed without a recognised engineering certification system. Why should we be content to have anything less for our IT&T infrastructure, which will match the physical infrastructure in time?

3.4.2 ACS core body of knowledge - a professional framework

In September 1997 the ACS approved a 'core body of knowledge for all information technology professionals". This will underpin future assessments for professional membership and recognition of tertiary level courses by the ACS. The core body of knowledge represents the fundamental skills that will be required of any IT&T professional in the immediate future. Our core body of knowledge recognises that employers in the IT&T industry require a range of people and project management skills as well as the specific technical knowledge of the profession.

Together the core body of knowledge and ACS guidelines for accreditation of courses at the professional level represent a distillation of the IT&T industry requirements of graduates and the universities that produce them.

Table 3.4: IT&T mandatory areas of knowledge

Group 1		
Interpersonal communications		
Ethics/Social implications/professional practice		
Group 2		
Data structures and algorithms Program design and implementation Software engineering and methodologies Security	Conceptual modelling Systems analysis and design Database management	Computer organisation and architecture Systems software Data communications and networks Discrete mathematics

The ACS core body of knowledge for information technology professional is enclosed as Attachment 2.

The ACS endorses the suggestion that key IT&T industry bodies together with the profession provide independent accreditation for IT&T related courses and courses with a significant IT component. The ACS already accredits the main university based IT courses. In addition, the ACS has a fully developed core body of knowledge and proven framework for assessing curriculum and the suitability of universities to deliver IT&T programs. The purpose of the core body of knowledge is to provide professional accreditation in other disciplines if there is a significant IT component in the educational preparation. The ACS is then able to provide an endorsement to the professional status of individuals graduating in these disciplines.

The ACS (the profession) does not believe it is its role to define how core IT&T skills will be developed through specific design of university courses - curriculum design is an activity best left to the educational professionals, and diversity in curriculum content and delivery is likely to lead to higher quality IT&T courses as universities seek to attract the best students through their subject offerings.

However, the ACS recommends that any university seeking to deliver IT&T programs must meet the core knowledge requirements developed by the ACS on behalf of the IT&T industry.

3.4.3 Cross-sector co-operation

Delivery of IT&T programs is not limited to universities. The Vocational Education and Training (VET) sector is a significant supplier of IT&T skills. Development of IT&T programs at the university level must integrate and complement VET level programs. Co-operative delivery and recognition arrangements such as those characterised by the arrangements between Monash University and Casey Institute of TAFE Victoria provide but one successful model of what can be achieved. The ACS has developed an integrated framework of course and provider recognition that accommodates both VET and higher education. The ACS supports the RHEF&P objective articulated in *Learning for Life* on the alignment of the VET and higher education sectors in Australia.

3.4.4 Ongoing professional development

Currency of IT&T knowledge and skills is a critical issue. Three or four year undergraduate programs may be required to establish the fundamentals, but the pace of change in hardware and software requires much shorter, more flexible approaches to skills updating for the profession as a whole. Universities must take a lead in providing shorter re-certification and update programs, in conjunction with the appropriate professional bodies. Government support to skill maintenance within the IT&T industry through public higher education funding is warranted given the broad public benefit derived from an active and growing knowledge based industry and portability of IT&T professionals.

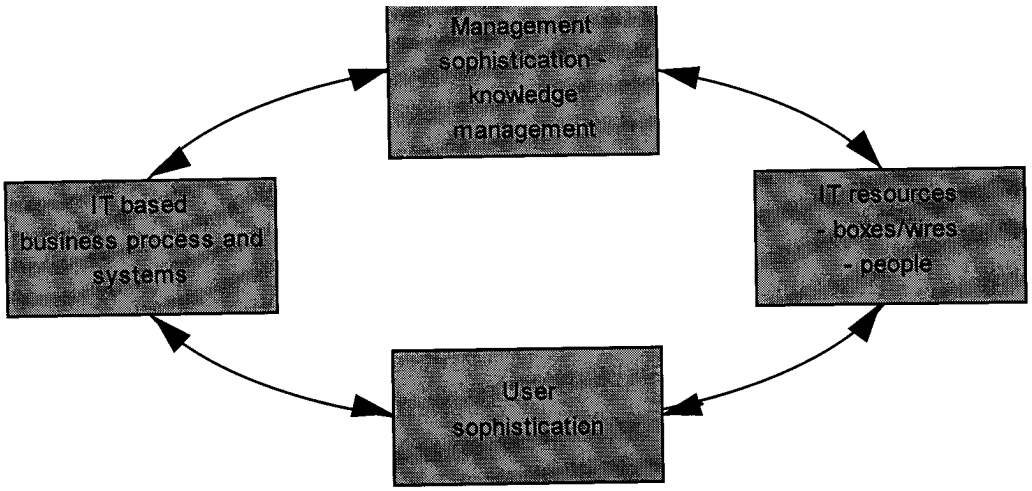
The ACS recommends that the proposed entitlement to post secondary study for all Australians must be structured to allow 'cashing in 'for both full-time undergraduate or post graduate study and post graduation professional development programs that have formal industry recognition.

3.5 IT&T capabilities and knowledge organisations

If we focus solely upon the number of IT&T specific graduates we ignore the extent to which Australian employees across all industries, occupations and levels are using some form of computerised technology or application in order to "do their work" - ranging from simple key boarding to highly sophisticated computational, design and modelling functions.

This transformation of the business and industry environment means that four types of IT&T knowledge and expertise (or capability) will be required of firms and all the employees within them.

Figure 3.1 - IT&T capabilities



Under this model, a narrow focus on IT&T resources, ("computing specialists") hides the real level of IT&T capabilities required, and as a consequence the expectation of firms that all professionals recruited with university qualifications will bring with them some level of IT&T sophistication. In order to achieve this the use of IT&T for educational interaction needs to increase, and consideration of specific orientation of the curricula of all discipline areas to foster IT&T capabilities in undergraduates is required.

IT&T is transforming the capabilities required of traditional organisations. It is also establishing the platform for significantly different forms of working arrangements and organisational forms. Telecommuting, "hot decking" and other work options are a growing fact of organisational life. Changing federations of networked individuals and small businesses may be the future organisational form[7] . The kaleidoscope will provide the organisational metaphor for these arrangements.
While current statistical reporting does not allow precise definition, recent estimates indicate that "symbolic analysts", workers who create knowledge and innovation from information, hold a less

[7] Reich, R. (1991) *The work of nations: preparing ourselves for 21st century capitalism* London, Simon & Schuster.

significant presence in the Australian labour market[8] than would be expected of a nation which aspires to be internationally competitive, globally active and operating at the high value adding, high skills end of the development spectrum.

In developing the policy framework and funding incentives for Australia's future university system these fundamental changes wrought by IT&T must be taken into account. Our university system must support and lead the development of Australia's knowledge industries, of which IT&T is an integral component.

[8] Maglen, L. (1994)

4 IT&T and higher education delivery

4.1 **Converging trends for higher education**

Many commentators have noted the emerging social and technological trends that are converging to change fundamentally the nature of higher education from the scholastic (and monastic) model that emerged with universities in the middle ages. These drivers of change are:

- the increasing heterogeneity of the student population. Student populations are increasingly representative of the general population. Greater heterogeneity of students will involve greater variety of learning styles, support requirements and access arrangements. The predominantly mass production processes of educational delivery are insufficient to meet these needs;

- the emergence of mass higher education, which is now deemed a necessity, coupled with higher short term contributions to the cost of the education will produce an educated consumer who is more likely to be a demanding consumer. The need to resolve the tension created by mass participation and demand for more individualised services will be a major issue in the next 20 years;

- increasing competition, both between universities in Australia, with universities from other countries and with emerging substitutes for the university experience (including work-based learning and the infotainment industry) inevitably has ramifications for the structure of the education industry and the service it provides;

- limited and declining levels of public resources for higher education are forcing universities to seek alternative revenue streams. The notion of the university as a "business" is more widespread;

- the impact of information technology that will revolutionise the capacity to create, manipulate, store and transmit information should therefore transform the educational enterprise. However, technology should not become a barrier to entry to higher education - neither because of low levels of technological facility possessed by individuals nor the inability to finance the acquisition of computing equipment.

The promise of information technology is that it will profoundly alter the educational paradigm. This promise is commented upon a number of times in the RHEF&P discussion paper. The discussion paper assumes that IT&T will:

- assist in expanding the reach of, and access to, higher education both domestically and internationally; and

- reduce the cost of delivery of university programs.

4.2 The technological conundrum

In the face of the promise for education embodied in IT&T noted by the RHEF&P (and many others) the low level of use of computerised technologies in the delivery of higher education is a conundrum. The key to this conundrum is relatively simple - university staff are generally unskilled in the application of IT&T to teaching and there are insufficient incentives to develop these skills, either on the part of individuals or at the university level.

On one level universities have pioneered the use of technology to support research and development in general through their "first mover" use of Internet/e-mail to support research and communication.

On the other hand, despite the high penetration of technology supported research and communication, the delivery of education remains fundamentally unchanged - centred around the teacher as the source of knowledge and the on-site lecture/seminar as the point of transmission of that knowledge.

Despite the growth in off campus/distance delivery modes provided by universities, the pedagogic models remain unchanged. While most sectors of the economy have undergone a significant transformation and re-engineering of processes and systems as a result of IT&T, in education it has primarily been used to speed up learning and extend access (somewhat) to educational products.

The overwhelming response to information technology opportunities in other sectors has been to fundamentally rethink the business processes and work practices, however, process re-engineering in education is relatively rare, both in the "back room" (administration) and at the "chalk face".

If this is the case then why has it made so little difference to the predominant educational paradigm?

A few obvious explanations exist:

- the cost of establishing and maintaining the basic technological infrastructure (people and "boxes and wires");

- cost of courseware development. A lecturer may take five hours to prepare for an hour long lecture, which then only requires small updates over the medium term. To produce a high quality, interactive hour of computer based learning courseware will require hundreds of hours and diverse staff skills to prepare. The cost is too high for individual universities to contemplate in a systematic fashion;

- skill base and level of comfort with IT&T of existing academic staff. In some areas the overhead projector is a major technological advance while others are pioneering the use of technologies at their most leading edge;

- implementation of IT&T based educational delivery is small scale and piecemeal. Limited co-operation means duplication in developments. Large scale examples and development of good teaching practice based upon proven IT&T based delivery are not available;

- a simplistic approach to inter-institutional competition is creating barriers to co-operative effort in computer based learning materials development;

- there are insufficient incentives amongst universities to co-operate/share IT&T capital development costs;

- a limited strategic approach to development and maintenance of IT&T infrastructure, content and technical capability;

- absence of agreement to common and open standards within individual universities, much less across the universities as a whole.

4.3 Transforming teaching

IT&T offers enormous benefits to universities and all the key stakeholders (university management, staff end students):

- improved learner and courseware interactivity through multimedia;
- flexibility in provision and access;
- access no longer bound by geography;
- potential to reduce costs;
- improvements to the interaction between teacher and learner;
- more efficient delivery of student services and university management;
- access to global research networks and resources.

Most research into the effective adoption of IT&T in universities points to:

- the existence of a strategy and investment plan to support take up;
- high level support for IT&T ventures;
- appropriate development of and support to academic staff to enable them to master the new educational and technological requirements; and
- appropriate levels of technical support staff, including management of the technology and instructional design.

Focusing of support to academic staff will help to balance the misguided view that IT&T on its own is a panacea for education. Events have not borne out this belief. Academics need to be

assisted to rethink their role as teacher and the type of learning experience required. IT&T then provides a vehicle for achieving this new role.

A strategic approach to investment in teaching skills development, courseware and applications and shared large scale IT&T infrastructure is required.

Of these the most critical impediment is the general level of skills of the university teaching faculty. The requirement for formal teacher training of academic staff is a recent development.

Formal training in the use of IT&T as an educational delivery tool is even rarer. The transference of teaching method and content to an IT&T platform is not merely replacing a blackboard or overhead projector with a computer screen. IT&T involves the capacity for multi-dimensional presentation of knowledge. Animation and sound can be introduced. Programs will contain multi-dimensional links that enable navigation through information to suit the learning purpose, not just the organising purpose of an author. Participants will be able to "see" data behind graphs by clicking on them. References will be able to be replaced by links to the original sources themselves. This capacity requires a radical rethink of classic educational pedagogy and the role of the teacher.

University academics will not become adept users of technology for teaching just by hoping for this transformation - even though enthusiasts do and have emerged.

None of these changes will be costless. Yet arguably they are investments that must be made if the potential of IT&T is to be realised.

The ACS supports the thrust of the RFHE discussion paper in respect of providing incentives through resourcing for good teaching.

The ACS recommends the provision of targeted funding to:

- *develop teaching practice in IT&T based delivery of education;*
- *co-operative development of courseware across institutions;*
- *research and promulgate successful IT&T based teaching practice on a wide scale.*

Strategic funding by the Commonwealth should be matched by universities to maximise the level of investment in teaching skills development.

4.4 Retaining the best teachers

IT&T will change the interaction between faculty and students. E-mail makes staff more accessible. Old work practices of limited student contact time and the split between teaching and research activity may require rethinking. Not only will the teaching skills of academics require support but the terms and conditions of their employment and what may be required of them in terms of student interaction will have to be re-established.

Re-examination of academic terms and conditions is warranted not merely because of the potential implications of electronic communication for teacher student interaction.

Salaries of academic staff are falling well behind remuneration of skilled IT&T professionals. The capacity of universities to attract and retain highly skilled IT&T professionals for teaching and institutional support is limited.

The ACS supports the concept that improved rewards are required to ensure the best teaching staff are able to be retained by universities.

The ACS recommends that:

- *traditional terms and conditions of academic staff be re-examined to ensure that academic staff focus on excellence in teaching and the expanded interaction with students made possible by advances in telecommunications; and*

- *in light of changed expectations academic salaries be aligned to relevant industry benchmarks.*

4.5 Developing the IT&T infrastructure

There is a case to be made for regarding the IT&T platform of the higher education system in Australia as an essential facility requiring co-operative development, funding and management across the institutions. It should not be left, as it frequently is, to individual faculty or department level decision making.

A good IT&T infrastructure will be critical to the national and international competitiveness of the whole of the university system as well as individual universities. Leadership and co-operation in the development of this national capital and intellectual asset is required. Leadership from the highest levels within a university, and at the highest levels across the university system is required.

Co-operative action would:

- increase purchasing power for hardware and software;

- create a more viable market for courseware development;

- enable commercially attractive (for all parties) strategic alliances to be developed with local vendors.

The ACS recommends:

· *co-operative development of an IT&T strategy for the Australian university system between the AV-CC, DEETYA, the profession and the local industry;*

· *allocation of IT&T investment funding to support co-operative investments in common hardware, software and content delivery;*

· *capital funding to universities should be structured to provide appropriate incentives to invest in IT&T infrastructure for deliver;*

· *priority be given to research grants that involve collaborative use and reuse of technology and existing practice in technology based education delivery.*

4.6 Student access

All university students require a basic level of computing equipment and networked access to and within institutions now. This will become essential over the next 20 years and access to this may either become the entree or deterrent to a university education. Many students are meeting these investment costs at the present time, but not all.

Universities should be developing adequate network connection ports to aid student access to library, research resources, digitised courseware and academic staff. The types of access offered by some universities to off campus/distance education students should become the norm for all students. Capital funding should be tagged for this use.

The ACS recommends that the student "entitlement" should be structured at a level to allow all students to purchase appropriate computing equipment and software. Co-operative purchasing arrangements, either by the individual universities or the Commonwealth Government should be investigated to enable significant cost reductions through bulk purchasing arrangements for computer hardware and telecommunications tariffs on behalf of students. The purchase of a basic level of computing equipment should be a prerequisite for every course.

In addition, the ACS recommends that the resources made available at the institutional level through student self-provision with computing equipment be tagged for reinvestment in supporting infrastructure (particularly electronic networking) by universities.

4.7 Managing the university

First and foremost universities are teaching and research institutions. But even the smallest university in Australia is a big business. Thousands of staff are employed, millions of dollars of revenue are managed, critical capital investments are made and managed. Yet most indicators are that the benefits of IT&T are insufficiently applied to these activities. Just at the process of educational delivery remains significantly unchanged and unchallenged by IT&T, so too do institutional management and administrative practices.

The predominant exception to this is student administration. Universities have made significant advances in the use of IT&T to manage student administration systems. Most universities offer computerised enrolment systems and tracking of student progress. While the establishment of these systems involve significant up front investment, their cost benefit ratio is likely to be high. Additionally, as the primary clients of the university students are accustomed to the convenience and ease offered by IT&T in other spheres of life (ea. banking) and will demand similar levels of convenience from their universities.

Strong leadership in re-examination and re-engineering of administrative processes, and better use of IT&T to support these processes can result in significant cost savings and productivity for universities. Private and government sector organisations have realised major savings through close attention to re-engineering of major processes. It is hard to imagine that these success stories could not be replicated by universities.

Current approaches to recurrent funding from Government may not provide sufficient incentives to universities to maximise their IT&T support to administration. Future funding approaches should balance the incentives to produce the most cost effective administration systems that maximise the level of funding provided to educational delivery and research activities.

5 Concluding comment

In providing advice to the Government to guide the funding and policy for university education over the next 20 years the RHEF&P faces an enormous challenge in driving the potential impact of technology on the education industry. Its own advice suggests that over "the next 20 or so years technology will have a profound impact upon the structure of the higher education sector, across the total production and consumption system"[9] . In considering this effect the RHEF&P may also consider the broader implications of technology in Australian business and industry and the role of universities as suppliers of skilled graduates and active leaders and participants in research and development for IT&T.

The potentially profound influence of advances in IT&T has major implications for our universities and our broader IT&T industry. The scale and rate of change in IT&T over the last 20 years is an awesome indicator for the next 20. The impact can be expected to penetrate all aspects of university organisation, operation and resourcing, ranging across:

- teaching and learning styles, including the need for more large scale research into the useful application of IT&T in education;

- the relative computer literacy of existing (and future) university staff to their students;

- the university as a principal source of skilled "computer professionals", and as a potential source of maintenance of professional skills for the profession and its broader involvement in technology transfer through the preparation of professionals in other disciplines requiring high levels of technological literacy;

- over the next 20 years we can expect even greater advances in access to digitised primary and secondary research materials, simulations which will replace the need for much "live" experimentation and experience. These advances have the potential to reduce costs and significant expand the learning opportunities;

- higher levels of technology interaction including voice recognition, speech synthesis and handwriting recognition will become widely available and will further revolutionise the possibilities of educational delivery and student and teacher interaction;

- the Internet or the next generation telecommunications technology will mean that all knowledge is in the global domain. The issue then will be to equip people to access, sort and select information. Higher level knowledge management skills are required for all, and "knowledge professionals" will provide critical brokerage services. The IT&T industry and universities can be expected to be the seed bed for these developments;

[9] Global Alliance Limited *(1997), Australian Higher Education in the era of mass customisation.* Commissioned paper for the Review of Higher Education and Policy, pi O.

- the concept of the university as the preserver of culture and knowledge transmission will be fundamentally challenged by a wide variety of substitutes that may be more appealing to future generations of students, as well as more traditional domestic market challenges through the globalisation of the education market place.

Appendix 1: Penetration of IT&T

The IT&T revolution

Australia is a large user of IT&T:

- accounting for approximately 2% of total world IT&T consumption (compared to less than 1% of world IT&T employment);
- the number of PCs per 100 persons has increased from 11.5 in 1988 to 21.7 in 1993 (compared to a growth of 17.6 to 26.1 in the USA over the same period);
- per capita usage of computers is second only to the USA, and double the average in the Asia Pacific region (including Japan); its telecommunications infrastructure is ranked 11th in the world;
- between 1984-1994 household expenditure on computing equipment increased by a factor of 6.5[10] .

Few escape IT&T exposure in home or school

Exposure to IT&T is probably even greater than the figures above would suggest. A recent ABS survey of computer penetration of households indicates the extent to which an even larger proportion of the Australia population have access to computers in their own home.

Table 2.1 - Digital connectivity of Australian households (1996)

Category	Capability	Estimated no. Of households ('000)	%
No telephone, computer, modem	No telecommunications	222	3.4
telephone only	Voice communications	4,380	66.4
Digital - unconnected (telephone, computer, no modem)	Voice/data communication and networked computing	486	7.4

Source: ABS (1997) Year Book Australia

[10] Bureau of Industry Economics (1994). *Information and Telecommunications industries: an evaluation of the partnerships for development and fixed term arrangements programs*, Canberra, AGPS, p47-8.

By 1998 computer penetration of Australian households is expected to reach 38.1%, with over 50% penetration of homes which are in the high and upper middle income quintile, inhabited by couples with children and the site of home business[11] .

Table 2.2 further demonstrates the impact of education, work and entertainment on computer usage.

Table 2.2 - Computer activities of persons by age, Australia, February 1996

Activity	**Age group (years)**						
	5-17	**18-25**	**26-40**	**41-55**	**Over 55**	**Total**	**Total**
	%	%	%	%	%	%	'000
Playing computer games	50.4	13.3	19.9	13.3	3.1	100	2,346
Using mainly educational products	58.9	7.3	17.4	13.0	3.4	100	1,052
Doing work relevant to studies	45.8	20.6	21.1	11.2	1.4	100	1,620
Doing work for the home-based business	0.4	3.6	43.3	38.6	14.1	100	422
Doing work relevant to my business (excl. Home-based)	0.1	8.9	47.2	36.3	7.6	100	379
Doing work relevant to my employment (excl. own business)	0.8	16.6	44.1	35.8	2.8	100	833
Doing other paid work from home via computer	-	1.4	26.4	36.1	36.1	100	23
Keeping personal or family records	3.3	12.6	41.5	33.3	9.3	100	900
"Adult" entertainment products	-	20.9	55.5	23.7	-	100	28
Electronic mail	4.4	14.3	49.3	24.5	7.5	100	141
Accessing the Internet	10.7	18.0	37.6	28.0	5.7	100	262
Accessing other on-line services and databases	9.5	17.4	50.6	14.9	7.5	100	116
Other	6.0	12.9	26.9	35.7	18.5	100	263

Source: Household Use of Information Technology, Australia (8128.0), ABS, 1997

These technologies will further impact on the lives of Australians, as indicated by the emerging technologies that are revolutionising basic social and economic transactions, including:

[11] ABS (1997) Year Book Australia, Canberra, AGPS

- e-commerce;
- home shopping;
- electronic video malls;
- home banking;
- virtual reality banking;
- document retrieval;
- on-line reservation systems;
- telescript;
- news retrieval; and
- telemedicine.

Table 2.2 above demonstrates the depth and breadth of education and study on computer technology usage in the home. However, the impact of computer technology in the school environment will be even greater. Schools will be the incubators of a population with high levels of comfort and expertise in the use of computers to perform learning functions and, by implication, translate the skills into the performance of work. Recent surveys indicate that there is approximately one computer for every 15 school students in Australia[12] . The majority of Education Departments in Australia are establishing policy and infrastructure requirements so that computer-based learning extends across the curriculum, and a basic level of computer literacy is achieved by all students during their schooling years.

Many of the current generation of school students will progress into higher education and work with a higher level of expertise in computer use and a higher level of expectation that computerised technologies will be part of their ongoing educational or employment experience than those who will teach or employ them.

[12] Tinkler, Lepani, Mitchell (1996)

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