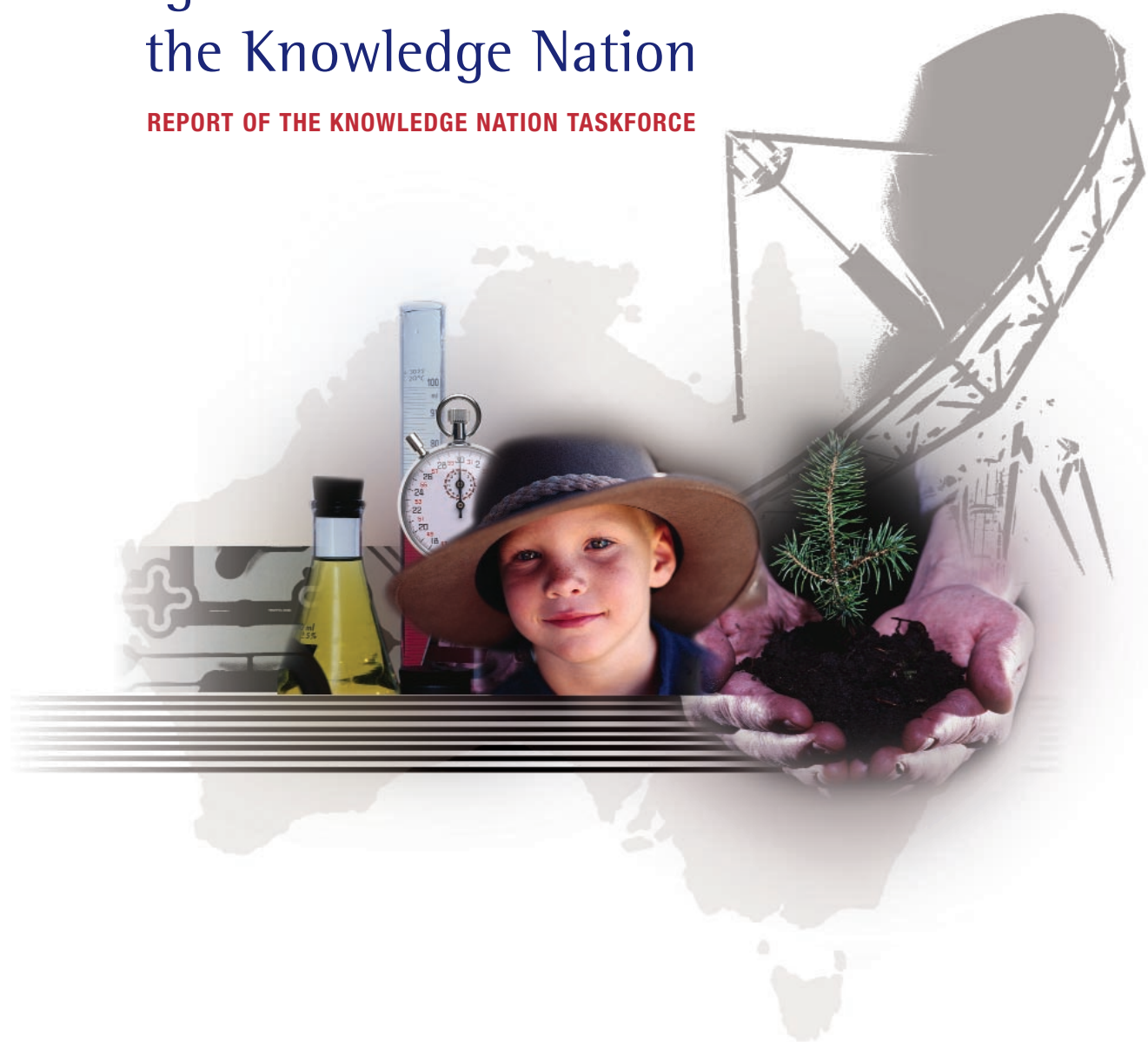# An Agenda for the Knowledge Nation

REPORT OF THE KNOWLEDGE NATION TASKFORCE

Chifley Research Centre
Canberra

Not to choose is to choose.

TALLEYRAND

The Abbreviations

ABC	Australian Broadcasting Corporation
ABS	Australian Bureau of Statistics
ADF	Australian Defence Force
AIMS	Australian Institute of Marine Science
ANSTO	Australian Nuclear Science and Technology Organisation
AP	Australia Post
ARC	Australian Research Council
B of M	Bureau of Meteorology
CGT	Capital Gains Tax
CoAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DDSO	Digital Data Service Obligation
DISR	Department of Industry Science and Resources
DNA	Deoxyribonucleic Acid
DSTO	Defence Science and Technology Organisation
EC	European Community
EPAC	Economic Policy Advisory Council
ETM	Elaborately Transformed Manufacture
FASTS	Federation of Australian Scientific and Technological Societies
GDP	Gross Domestic Product
HECS	Higher Education Contribution Scheme
ICT	Information and Communications Technology
IIF	Innovation Investment Fund
IP	Intellectual Property
ISDN	Integrated Services Digital Network
IT	Information Technology
IT&C	Information Technology and Telecommunications
Kbps	Kilo bits per second
Mbps	Megabits per second
MIT	Massachusetts Institute of Technology
NHMRC	National Health and Medical Research Council
OECD	Organisation for Economic Cooperation and Development
PMSEIC	Prime Minister's Science Engineering and Innovation Council
R&D	Research and Development
TAFE	Technical and Further Education
UK	United Kingdom
US	United States
VET	Vocational Education and Training

Key Characteristics of a Knowledge Nation

1. A government that creates and promotes effective linkages between research organisations—such as CSIRO, the universities, Cooperative Research Centres and Federal and State Government agencies—to ensure an adequate national database, and an inventory of skills, resources and the environment (cadastre).[1] The purpose is to enable effective coordination of national and regional efforts to tackle major problems that threaten the nation's viability, especially in regional and remote areas. Examples of such problems include desertification, soil salinity and acidification, pollution of rivers, and erosion.

2. A government that works imaginatively and creatively as a catalyst, encourager, information provider, infrastructure supplier, major customer, and example of world's best practice.

3. A national strategy of ensuring investment in those key areas where it can establish a leading global position.

4. A twenty-first century education system that:
   - provides all of its citizens with the opportunity to improve their skills and gain secure and well-paid jobs through properly funded lifelong learning and vocational education programs, including programs at the industry and enterprise level;
   - makes every school—State and non-government—a centre of excellence and provides all children with a quality education;
   - has universities that attract the world's leading researchers and teachers; and
   - encourages fundamental research and the study of the humanities as well as applied knowledge.

5. An economic system based increasingly on innovation and the creation and commercialisation of ideas, and that reverses the serious imbalance in trade in high value added goods and services. This means:
   - stronger manufacturing, extraction and service industries transformed by the application of new technologies and the re-skilling of their workforce;
   - the development of industries in emerging fields such as biotechnology, nanotechnology, information and communications technology, and environmental management; and
   - taking advantage of rapidly expanding export opportunities in service industries, particularly in education, health and environmental management.

6. Leading-edge telecommunications, transport and research infrastructure in our cities and regions and regional development as a core economic and social objective.

7. Policies that regard saving the environment as an opportunity, and promote sustainability. The application of knowledge to simultaneously promote energy efficiency and higher living standards and create more jobs.

8. A transformed national culture that emphasises knowledge, excellence and innovation and aims for this to be reflected in its international reputation. Like Ireland, Finland and Israel, our international 'image' must be transformed by creating an inventory of internationally recognised goods and services.

9. The use of knowledge resources to promote the public good, encourage access and equity, provide resources for Aboriginal and Torres Strait Islander peoples, and overcome social, class, regional, ethnic and gender barriers.

10. The creation of a more challenging and creative environment to help reverse the 'brain drain' and assist us in importing the skills we need.

11. The strengthening of great national institutions such as the ABC, CSIRO, galleries, museums, libraries, the Australia Council, the Australian Heritage Commission, Telstra, Australia Post and the Bureau of Meteorology.

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1 **Cadastre.** We have adopted this unfamiliar term as a convenient way of describing a comprehensive National Inventory or Knowledge Bank. The Cadastre would provide a picture of Australia's physical and human resources, both nationally and regionally. It would provide detailed access, for example, to material on the state of the environment, including details of water quality and availability, the extent and location of desertification, salinity and acidification of soils, health services, regional variations in life expectancy, research capacity, the availability and nature of employment, education levels and availability. The Cadastre would link the research bases of the Commonwealth and State, including the Census and the National Land and Water Resources Audit. Having the Cadastre would identify and quantify national problems and suggest priorities for overcoming them.

The Knowledge Nation Taskforce

The Knowledge Nation Taskforce comprises leaders from Australia's education and research institutions, policy experts and economists from the knowledge sector, high profile business leaders from the information and communications technology (ICT), biotechnology and sustainable technology industries, and State and Federal parliamentarians who have a particular interest in developing Australia's knowledge potential.

It is chaired by The Hon. Dr. Barry Jones, former Minister for Science and author of the acclaimed book, *Sleepers, Wake*! The Deputy Chair is Martyn Evans, MP, Federal Shadow Minister for Science and Resources.

The Taskforce was established by the Leader of the Federal Opposition, Kim Beazley, at the ALP National Conference in August 2000 to devise an action agenda for developing Australia as a Knowledge Nation.

The recommendations in the action agenda are those of the Taskforce, not the ALP, and are presented to Kim Beazley for his consideration and policy response.

The purpose of this action agenda is to define the Knowledge Nation and set broad strategic goals to guide policy development between now and 2010 for governments at the State and Federal levels.

The recommendations contained in this report are designed to build long-term advantage for Australia as a Knowledge Nation. They cannot be a quick fix. The Taskforce understands that the resources and priorities of governments change from year to year and therefore that the long-term investment we envisage will need to be adopted as a permanent priority for every Federal Government. The important thing is durable commitment and demonstrable progress.

The Taskforce and Kim Beazley's office received offers to make submissions from prominent Australians and major representative organisations. A list of individuals and organisations that made submissions is provided as an appendix to this document.

Acknowledgements

Membership of the Knowledge Nation Taskforce

Chair
The Hon. Dr Barry Jones AO, FAA, FAHA, FTSE, Minister for Science 1983–90, National President ALP 1992–2000, Visiting Fellow Trinity College Cambridge

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Professor Mairéad Browne, University of Technology Sydney

The Hon. John Brumby MP, Victorian Treasurer, Minister for State and Regional Development

Professor Peter Dixon, Director of the Centre for Policy Studies, Faculty of Business and Economics, Monash University

Clem Doherty, Chairman of Like-Minded Individuals, former Director of McKinsey and Company

Tracey Ellery, President, Looksmart

Dr Craig Emerson MP

Rosemary Herceg, CEO, Pophouse Pty Ltd.

The Hon. Dr Carmen Lawrence MP, Shadow Minister for Industry, Innovation and Technology, and for the Status of Women

Senator Kate Lundy, Shadow Minister Assisting the Shadow Minister for Industry and Technology on Information Technology

Professor Jane Marceau, Pro Vice-Chancellor, Research, University of Western Sydney

Aidan McCarthy, Director of Information and Learning Technologies, John Paul College, Brisbane

John McFarlane, CEO, ANZ Bank

Kevin Rudd MP

Stephen Smith MP, Shadow Minister for Communications

Evan Thornley, CEO, Looksmart

Professor Bob Williamson FAA, FRS, President, Association of Australian Medical Research Institutes

Nabeel Youakim, Managing Director, Citrix Systems, Asia Pacific

Cathy Zoi, Executive Director, Next Energy, and former Chief of Staff White House Office on Environmental Policy under President Clinton

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SUMMARY OF RECOMMENDATIONS

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Summary of Recommendations

What is to be done?

In the face of a changing world economy where knowledge is paramount, Australia is facing a national crisis.

The only way forward is for Australia to become a courageous and effective Knowledge Nation in which everyone participates and shares the benefits.

Government leadership and commitment

Becoming an effective Knowledge Nation requires aggressive and sustained leadership from the Commonwealth Government, and particularly the Prime Minister, to create a national strategy and change the culture.

RECOMMENDATION 1

The Prime Minister must take the lead in advocating Australia as a Knowledge Nation, domestically and abroad, acting as a catalyst to change the culture to that of a Knowledge Nation. The Prime Minister should:

- call a Knowledge Nation Summit to begin the task of breaking down isolation and creating linkages between key players;
- outline a specific national strategy with specific priority industries and supporting a policy framework in education training and research to propel those industries into global leadership;
- conduct an international campaign to change the world's image of Australia to that of a Knowledge Nation; and
- report annually to the Parliament on progress in creating a Knowledge Nation.

Create an inventory of existing knowledge resources (cadastre) as the starting point for making connections and utilising Australia's full potential

While in some ways Australia is already on a path to becoming a Knowledge Nation, we are a disconnected and under-performing one. We must have a clear picture of our resources and optimise their use.

RECOMMENDATION 2

The Commonwealth should coordinate with the States and major research organisations the development of a comprehensive and broadly available inventory (cadastre)

of Australia's resources and knowledge capacity, as a basis for action and policy formulation. The information gathered must be accessible to all Australians.

Increasing and targeting R&D

Government should be in the business of determining priority industries; it should not be in the business of trying to pick winning companies. But fear of 'picking winners' should not be allowed to constrain Australia from developing a national investment strategy. Such a strategy would build on areas of strengths in existing globally leading industries (including those in the resources and manufacturing sectors) and potential strengths in emerging industries (including ICT, environmental management, and biotechnology and medical research). Government would work with them to provide a critical mass of infrastructure and R&D incentives and to develop management expertise and a skilled workforce.

RECOMMENDATION 3

Australia should increase its public and private sector R&D performance by:

- Doubling Australia's overall R&D as a percentage of GDP by 2010, bringing Australia to the top of the OECD tables.
- Targeting R&D incentives and action agendas to key Knowledge Nation industries, including the industries with currently globally competitive positions such as wool, tourism, wine, iron ore, coal and beef; established potential growth industries such as education, health and medical research; and emerging industries such as ITC, environmental management and biotechnology. Additional areas for national effort should be decided through a national foresight process that brings together experts from across society to identify opportunities for economic improvement.
- Using the nation's investment promotion program and other measures to expand our productive capacities in elaborately transformed manufactures (ETMs) and foster the linkages that will accelerate the rate Australia develops new products, forms new companies and commercialises technology.
- Drawing on existing university and non-university research bodies to build three national institutions of global standing in the three key emerging sectors of ITC, environmental management and biotechnology.
- Creating an Institute for Manufacturing as a centre of excellence for industry research and development.
- Introducing additional R&D concessions for businesses in selected sectors that conduct research in conjunction with public sector research bodies and universities.

- Promoting the core enabling disciplines within the fields of science, engineering, the social sciences and the humanities, in school and higher education.
- Increasing support for the CRC program while ensuring rigorous selection processes for the establishment of new CRCs. This should include the creation of a number of additional CRCs in ITC, environmental management and biotechnology.
- Significantly increasing funding to public sector research bodies, including the CSIRO, AIMS, the NHMRC, the ARC, the Bureau of Meteorology, ANSTO, DSTO and others.
- Using the Australian Defence Force's acquisition program to support Australia's high-technology industry base and encourage research and development of leading-edge technologies.

Commercialising Australian R&D

Australia needs to acknowledge that we are competing with other nations that have tax and other incentives for the commercialisation of research in emerging industries.

Unless Australia addresses the commercialisation issue, we will fail to maximise the benefits from public and private investment in research through CRCs, early stage companies, incubators, institutes, universities and other bodies.

We must also change Australia's culture to ensure greater recognition of the importance of prudent risk taking and entrepreneurial activity in commercialising Australia's world-leading research.

RECOMMENDATION 4

The Commonwealth Government should undertake a thorough review of the impediments to the commercialisation of Australian research, in targeted emerging industries. This strategy should:

- benchmark Australia against other successful Knowledge Nations, such as Ireland, Israel, Singapore, Canada, the United Kingdom and the United States; and
- recommend tax changes and other financial incentives that will encourage greater commercialisation (see also Recommendations 3, 5, 6 and 7.)

Key industries 1: Information and communications technology

Due to policy failures, Australia is not a pace setter and leader in ICT; we are a user and follower. Our goal must be to be both a high user of new technologies and a creator of them.

Every ICT policy we adopt must incorporate the principle of universal access. Australia must close the digital divide.

ICT is embedded in almost every industry and activity of a Knowledge Nation. Creating high-level capacity in ICT infrastructure and skills is an essential prerequisite to modernising Australia's education, health and other services, strengthening existing manufacturing industries and creating new industries.

RECOMMENDATION 5

The Commonwealth should make it an urgent national priority that all Australian households and businesses have the option of access to digital broadband. This could be done by:

- Using the array of Commonwealth power, capacity and influence to expand broadband access. This will include improving the current regulatory arrangements and maintaining majority government ownership of Telstra.
- Upgrading the current standard telephone service, which mandates minimum levels of voice telephony service, to a standard communications service that mandates minimum levels of data transmission.
- Improving the competitive and regulatory environment to ensure fair access to the Customer Access Network and to ensure that broadband networks are open, digitised and inter-connectable as soon as possible.
- Providing incentives, including investing in broadband networks, for the take up of broadband technology.
- Making government a leader in the use of high broadband technology, including innovative online government services.
- Ensuring that all Australians, particularly those in regional areas, have the opportunity to access fixed-price untimed calls nationwide, for both voice telephony and data services.
- Removing the existing restrictive and failed datacasting regime and opening up a new digital spectrum to the exciting, potential new services of the future.
- Building a national strategy around the growth and development of Australia's software and digital content sector, including a comprehensive capability inventory.
- Using improved government procurement policies to encourage the further development of an Australian ICT industry.
- Closing the digital divide by using community and regionally based strategies to improve skill levels and assure affordable Internet access.

Key industries 2: Making Australia a world leader in biotechnology

Australia lacks a national policy that promotes research, development and commercialisation in the life sciences. We must build on our strengths in medical research to become a world leader in biotechnology.

RECOMMENDATION 6

The Commonwealth must build on Australia's strengths in medical research by adopting a goal of making Australia a world leader in biotechnological research, development and commercialisation by 2010. This will require:

- A meeting of the nation's biotechnology experts to determine a coordinated National Biotechnology Strategy for the development of the industry in Australia as a priority.
- Restructuring of NHMRC and ARC grants to allow for large-scale, biotechnology projects of national significance.
- Funding an Australian Genome Project and a National Proteomics Project to concentrate research effort and build on existing Australian strengths.
- Developing three life science research institutes of undisputed global standing. One of these may be designated a National Life Sciences Centre. All three should be built on the existing (and largely rusting) institutional base.
- Creating a network of biotechnology business incubators.
- Creating a biotechnology industry-wide information Internet portal—or a 'BioInfoHub'.
- Establishing a National Biotechnology Advisory Committee headed by a chairperson of global standing in the industry, serviced by an Office of Biotechnology within the relevant agency in Canberra.
- A detailed review of the impact of the tax system on biotechnology start-up companies and foreign investment.
- Specific adjustments to national immigration policies to encourage global-leading biotechnologists to come to Australia and expatriate Australian leaders to return.
- Developing a National Code of Ethical Practice for the Australian biotechnology industry.

Key industries 3: The environment as a challenge and opportunity

If we use our Knowledge Nation capacity in a focused way, we can improve Australia's calamitous environmental situation and create a potentially huge export industry in environmental management products and services, particularly in the areas of land care, water and waste management, and energy efficiency.

RECOMMENDATION 7

That the Commonwealth initiate a massive campaign, in conjunction with the States and all major research organisations, to start a ten-year program to tackle the problems of salinity, land degradation and acidification of soils, polluted rivers and sea coasts, land clearing and deforestation, loss of species diversity, and to implement a strategy to expand Australia's environmental management industry, for which we already have a high-level capacity. Elements in this strategy should include:

- a goal of obtaining a significant proportion of the global market of environmental management goods and services by the year 2010;
- development of a specific set of quantitative metrics and milestones for the year 2010 and each year beforehand to monitor success and highlight failures as the program unfolds;
- a targeted environmental management R&D program, including support to improve the sustainability performance of industries that have traditionally been both environmentally damaging and global leaders, and to generate new export industries from the expertise developed in doing so;
- the creation of environmental management CRCs, innovation investment funds and venture funds leading to the development of significant indigenous industries in environmental management;
- an environmental technology and services export program;
- renewable energy and energy efficiency initiatives;
- specific adjustments to national immigration policies to encourage environmental scientists and management professionals who are global leaders to migrate to Australia and the return of expatriate Australian leaders; and
- a campaign to promote understanding of the process of 'dematerialisation' in industry and the community.

Key Industries 4: An education export industry

Online education has moved beyond the realm of risky dot.com ventures into reality. Unless Australia establishes a leading online education industry that emphasises quality, millions of dollars and thousands of jobs for Australians will be lost overseas.

RECOMMENDATION 8

Australia must aim to become a world leader in online education at all levels within the next few years, winning at least 10 per cent global market share of revenue. Achieving this will require:

- ensuring that courses are as good as, if not better than, those offered in traditional formats;
- upfront investment to create quality online courses and retrain teachers and academics in their effective use;
- developing a leading online education content industry and encouraging the industry to adopt leading-edge methods of online marketing and distribution to attract students;
- research into the most effective online teaching, user interface requirements and online customer service infrastructure;
- improving to necessary infrastructure, including access to affordable bandwidth (particularly in regional Australia), adequate computer backbones and digitised libraries;
- financial incentives for students to study online, the availability of widespread public information on courses, and simple 'one stop shop' enrolment processes; and
- ensuring that individual academics, universities, TAFE colleges and private vocational education providers benefit from the creation of intellectual property.

Key industries 5: A medical export industry

Like education, the health care sector has significant export potential. Developed carefully in parallel with a strong universal health care system, this industry can generate revenue to improve health care for all Australians and create thousands of well-paid jobs.

RECOMMENDATION 9

Australia should develop and implement a strategy to make Australia a leading provider of health services to the Asia-Pacific region. This strategy should include:

- developing and marketing medical, paramedical and nursing training programs for the international market, utilising all the latest education tools including online learning;

- funding and administrative support for the development of super-speciality centres of excellence in Australia, which are directed at the international market as well as the Australian market;
- supporting areas of Australian strength in medical research, such as tropical medicine;
- further developing the nation's telehealth capacity and marketing these services internationally; and
- establishing relationships with surrounding countries so that Australia can sell complex medical treatment for their populations, enabling the nation to lock into a leadership position in the region in those areas in which it is world competitive.

A Year 12 school retention target

There is a mistaken view that creating a Knowledge Nation is only about assisting universities and scientists. A Knowledge Nation is about raising the standard of education at every level, and providing linkages with all aspects of Australian life. As a starting point, we must set ambitious targets for increasing school retention and boosting post-compulsory education and training.

RECOMMENDATION 10

Australia must ensure that by the year 2010, a minimum of nine out of ten young people leave their teens with a Year-12 or equivalent qualification, and that all young Australians achieve a formal education or training qualification at the post-compulsory level.

Revolutionary improvements to our schools

Our aim must be to ensure that all children, regardless of their parents' wealth, have access to a quality education and the same chance to achieve their full potential. This does not mean little changes; it means revolutionary changes.

Creating the Knowledge Nation will depend largely on the professionalism and dedication of Australia's teachers. They are one of our nation's most important assets. We must value them and give them the resources they need to fully develop the nation's knowledge potential.

RECOMMENDATION 11

The Commonwealth and the States should overhaul and modernise Australia's schools by:

- increasing the proportion of Commonwealth money going to public schools and funding non-government schools on the basis of need;
- raising school participation through a targeted program that tackles the causes of disadvantage;

- creating more linkages and co-location between schools and universities, including ongoing teacher skill development programs and mentoring programs for disadvantaged high-school students;

- investing in the creation of a modern teaching profession through ongoing training and re-training programs, providing financial incentives to teachers to upgrade their skills and qualifications, and, in partnership with the States and Territories, raising the standing of the teaching profession, particularly in critical areas of shortage such as science and maths;

- making ICT literacy a core component of learning alongside literacy and numeracy by providing ongoing training for teachers in the use of ICT in the classroom, ensuring there is a national educational Internet portal for all schools and members of the community to use, expanding 'cyber libraries', making Internet access more affordable for all schools, and encouraging schools to develop and share high-quality online curricula; and

- providing children, from kindergarten through to Year 12 with a variety of experiences, encouraging a spirit of curiosity, excitement and their capacity for conceptual thinking to make linkages, form judgments, and to feel a sense of empowerment in a variety of disciplines, including language, music, art, sport, mathematics and communications.

End the tertiary education funding crisis

The most visible effects of our national investment crisis can be seen in our universities. They urgently need a reinvestment and modernisation strategy.

RECOMMENDATION 12

The Commonwealth should tackle the university funding crisis by:

- boosting the number of university positions by an amount necessary to meet industry needs and maximise Australia's capacity as a Knowledge Nation by 2010;

- significantly increasing overall public funding of universities, including base operating funding, so they can continue to provide quality education and attract the best academic staff;

- improving staff development opportunities in universities;

- providing more incentives for people to study science and mathematics;

- reviewing HECS to ensure it does not act as a financial barrier to students, particularly mature-aged students and those from lower socio-economic backgrounds; and

- ensuring that all universities have the capacity to identify their own priorities and specialities from within the suite of national priorities and not be forced into a one-size-fits-all model.

A stronger vocational education and training system

The overwhelming majority of those who will be in the workforce in ten years time are existing workers. If these workers are to participate in the Knowledge Nation rather than be condemned to increasingly temporary and insecure employment, there must be specific initiatives to increase their access to vocational education and training.

RECOMMENDATION 13

Australia's vocational education and training system should be strengthened by:

- increasing funding to TAFE, targeted towards strategic industries and skills and those in the community who are in danger of being excluded from the Knowledge Nation;

- ensuring that employers increase their level of investment in employee training that will lead to national qualifications;

- requiring companies restructuring their business to provide adequate notice and allow staff time off to participate in recognised education and training;

- improving vocational education and training in the workplace by adequately resourcing vocational education and training at the industry and enterprise level and further developing industrial partnerships through Industry Training Advisory Boards and the Australian National Training Authority; and

- creating strong quality assurance mechanisms for vocational education.

Investing in early learning

A growing body of literature on early childhood development indicates that what happens in the first years of a child's life can strongly influence that child's performance at school, whether he or she works and at what type of job. Investing in early learning, particularly for those in disadvantaged communities, can therefore be one of the best investments we can make in improving social equity and raising our nation's future knowledge capacity.

RECOMMENDATION 14

The Commonwealth Government should develop a comprehensive National Early Assistance Strategy for Australia's children and families, encompassing all levels of government and local communities. This strategy should

be developed with the State and Territory Governments and be designed to deliver services such as:

- effective and accessible high-quality childcare and early childhood education, especially in lower income areas, in both the cities and the country, which enables parents to balance work and family life and promotes early childhood development;
- home visiting, or similar outreach programs for families with newborn children;
- linked family and community centres;
- locally responsive social security and employment services;
- linked community health services; and
- coordinated information and support services, including telephone advice lines for parents.

Rebuilding the ABC

The Knowledge Nation is not just about education and industry; it is about deepening and broadening the culture of the whole community. This task requires the existence of a well-funded and commercially independent national broadcaster.

RECOMMENDATION 15

Provide an adequate level of funding for the ABC as the quintessential Australian portal and to ensure a well-resourced, genuinely independent and truly national public broadcaster. In particular, to ensure that adequate funding exists for the production of popular, original world-class Australian drama, comedy and current affairs programming that may not otherwise be commercially self-sustaining in small markets such as Australia.

A plan to tackle the 'brain drain'

Nine leading Australian medical researchers, including Nobel Laureate Professor Peter Doherty, work in just one U.S. research institute—the St Jude Children's Research Hospital in Memphis, Tennessee. We need to encourage them and thousands of others like them in a variety of industries and occupations, including managers and business people, to return, bringing with them their experience and contacts. We also need to attract more scholars and business people of international calibre to work in Australia.

RECOMMENDATION 16

The Commonwealth should create an inventory of all recent Australian graduates with research degrees who are living abroad, and a register of resumes and contact details for private sector employers. It should also create at least 1000 additional publicly and privately financed commercial and university research positions to enable those wanting to return to Australia to do so and to attract leading scholars and researchers from other countries to move to Australia to live and work.

A National Information Policy

Access to information in Australia is currently very poor. Our principle should be that information paid for by the Australian people through their taxes should be readily available to all Australians.

RECOMMENDATION 17

There should be a National Information Policy to ensure access and equity in securing knowledge, to set out the rules by which information will be available as a public good, outside commercial exploitation, and to provide the basis of public policy that will be applicable to new technological developments. This policy should ensure that:

- There is wide public access to the world of knowledge, including leading scholarly journals and other publications, through public libraries, education institutions and at home via the Internet, provided to the nation through the aggregation of the Commonwealth and the State's purchasing power.
- Important ABS data is free of charge to those who need it.
- There is adequate public consultation and debate on ethical and human rights issues, including disability access, privacy and security, which arise as we move towards a society where more confidential information than ever before may be in an accessible electronic form.

A Population Policy

In the face of increasing global competition for knowledge and skills, Australia should develop a national population policy that plans for future skill needs in 'emerging' industries and builds the right age profile for future economic development. We must also utilise the knowledge and experience of people in the Third Age.

RECOMMENDATION 18

Australia must adopt a National Population Policy that is based on a national, rational debate about Australia's carrying capacity and the implications for resource use; relies on an adequate database drawn from the cadastre; and distinguishes population policy (inevitably long term) from immigration practice (decisions made year by year). As a matter of urgency, visa processes for highly skilled scientists and technicians must be streamlined and overseas students with sought-after skills must receive greater encouragement to remain in Australia. Australia should also do more to use the experience and knowledge of people of the Third Age.

Improve the position of the humanities, social sciences and the arts in Australia

If we are to become an innovative society as well as a modern economy, we must not replace the richness of a broad and deep education with 'knowledge' that concentrates only on science and 'skills', important though these are.

The expansion of the university system to create a Knowledge Nation must include a corresponding improvement in the position of the humanities and social sciences. The arts, which are increasingly becoming the key providers of 'content' for information-based industries must be nurtured and expanded.

RECOMMENDATION 19

The humanities, social sciences and creative industries in Australia should be strengthened by:

- creating extra entry-level positions for a new generation of humanities researchers and lecturers in our universities;

- a reasonable share for the humanities and social sciences of funding increases for research through the ARC;

- creating partnerships in the humanities and social sciences to explore the commercial application of these disciplines and boost the creation of educational content;

- a renewed national effort to boost second language training;

- strengthened government support for the arts and creative industries through funding for the ABC, the Australia Council, the nation's galleries and other important public institutions; and

- humanities and social science representation on the Prime Minister's Knowledge Nation Council, which will replace the Prime Minister's Science Engineering and Innovation Council ('PMSEIC') (see Recommendation 20).

New government structures to implement change

New government structures will be needed to assist the Prime Minister in the task of leading change.

RECOMMENDATION 20

To drive the creation of the Knowledge Nation across government(s) the Commonwealth should:

- adopt a whole-of-government approach to the creation and commercialisation of knowledge;

- elevate the importance of science within the Commonwealth Government and make the Prime Minister the Minister for the Knowledge Nation;

- broaden PMSEIC into a Knowledge Nation Council, with the full resources of a Knowledge Nation policy unit within the Department of the Prime Minister and Cabinet; and

- ensure that CoAG maximises the overall benefit to the nation of strategic investment in knowledge-based infrastructure, including school funding, university research investment, environmental management, and public health provision and research.

INTRODUCTION BY THE TASKFORCE CHAIR

The Hon. Dr Barry Jones
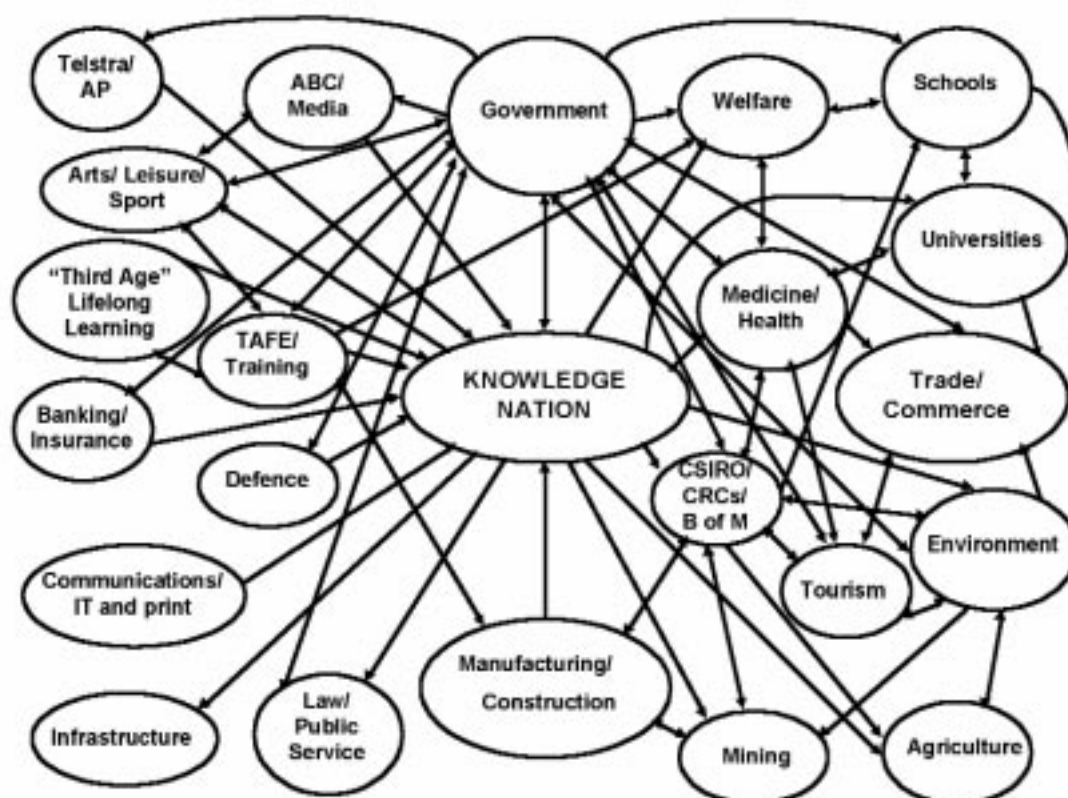
What is a Knowledge Nation?

A Knowledge Nation (sometimes called an 'information society') is one in which the largest section of the labour force is employed in processing information, broadly defined, which has the capacity to generate knowledge industries, and in which the products of research are directly applied in economic and social activity—health, environment, agriculture, mining and manufacturing, construction and infrastructure, transport, leisure activities, education, media and information.

The terms 'information society' or 'information economy'[2] were widely used in the 1980s when the transmission of encoded information was recognised as the common factor linking biology, zoology, genetics, biotechnology, computing and telecommunication. Information was seen as a 'transforming technology'. The 'Knowledge Nation' concept is far broader, with its emphasis on cognition and understanding used in a human, social context, rather than concentrating on techniques of transmission, such as information technology, as if they were ends in themselves.

The Knowledge Nation is a unified concept, a new paradigm, which links together:

- education—schools and universities
- training—vocational education and training (VET) and technical and further education (TAFE)

- lifelong learning and 'the Third Age'
- research—CSIRO, ARC, NHMRC, ANSTO, the AIMS, the CRCs, the Bureau of Meteorology
- innovation
- technology
- agriculture
- mining
- manufacturing
- infrastructure
- tourism
- law and public service
- trade and commerce
- banking
- communications and media (notably the ABC)
- information bases, including libraries and museums
- entertainment, the arts and leisure
- time/use value—rethinking the value of life outside work
- human rights
- welfare
- medicine/ health
- environment
- other services, and
- resource auditing (a cadastre)

FIGURE 1: The complex interactions between the elements of the Knowledge Nation

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2 The term 'knowledge economy' was coined in 1969 by the American social scientist Peter Drucker.

The common element is the ability to use knowledge to transform society, the economy and the environment.

Information or knowledge workers have comprised the largest Australian employment sector since 1966. They now number about 40 per cent of workers, far more than manufacturing, construction, agriculture and mining combined. They include people who create, manipulate, store, process and transfer information, working with symbols, or symbolic objects. Increasingly, knowledge workers can be found in all industries, not just those thought of as 'new'. In fact, more and more, the 'traditional' industries—manufacturing, construction, agriculture and mining -require employees to be knowledge workers.

'Dematerialisation' or 'the weightless economy'

Unpalatable though it might seem, Australia has to face up to and understand the concept of 'dematerialisation' or 'the weightless economy', with all its threats and opportunities. Europe is well aware of its implications, but the Bush Administration in the United States is committed to increasing levels of energy consumption. This is demonstrated by the divergent approaches to the Kyoto Protocol on greenhouse gas emissions. (BP and Shell, both European companies, promote energy efficiency, while Exxon from the United States rejects it.)

The Information Revolution, based on computing and the principle of 'miniaturisation', overturned some traditional assumptions in economics. As capacity increases, cost and resource consumption relative to output *falls* instead of rising, as might have been expected. Unlike coal or wood, information as a raw material is used but not consumed: it is sent, but the sender retains it.

As early as 1988, the OECD drew attention to the phenomenon of 'dematerialisation', the prospect that energy, hardware and materials would be a declining share of world trade, and the terms 'Factor Four' and 'Factor Ten' were coined. Factor Four is a projection that the use of fossil energy will drop by 75 per cent by 2030 and Factor Ten that per capita material requirements will fall by 90 per cent by 2050.

Neither Factor Four nor Factor Ten would involve a reduction in quality of life. Increased efficiency will provide the same outputs, for example in transport or domestic heating, with dramatically reduced inputs. Use of e-mail—as distinct from conventional letter delivery by post—is a familiar illustration of 'dematerialisation'. So is the World Wide Web—a library with billions of pages that can be accessed from a hand-held terminal. The Google search engine claims access to 1.35 billion pages, equal to 54 kilometres of library shelving.

Australia cannot just play the 'catch-up' game. As Dr Robin Batterham, Chief Scientist for the Australian Government, wrote in his recent report The Chance to Change, we cannot just be 'fast followers', asserting that if we redouble our efforts in a decade we can be where the Koreans were 20 years ago. We must leapfrog well into the twenty-first century.[3]

'Old' and 'New' Economy

One reason for the slide of the Australian dollar to around 50 cents US (see Figure 2) is that we are perceived as having an economy based on the exploitation of raw materials, that is, an 'old' economy. The falling dollar was very good for traditional exports (a 25 per cent increase in 2000, the best figure since 1979) and reinforces our dependence. Some industries have old and new characteristics—for example, the mining industry is a major creator of information products.

Australia is going through a transitional period, moving, rather slowly, from the old economy towards the new economy. Most of the entrants in the *BRW* Rich 200 list (18 May 2001) are firmly in the old economy.

A Knowledge Nation will create stronger linkages between old and new elements in the Australian economy (see Table 1).

Unlike, say, Sweden, with its familiar brand names (Volvo, Saab, Scania, Bofors, L. M. Ericsson, Hasselbad, Husqvana, Orrefors, Atlas Copco) or Finland (Nokia, Kone), Australia suffers from a serious 'inventory problem', the lack of internationally recognised brand name goods and services for which there is high and rising demand. Foster's and Qantas are among the few on the list. In world economy rankings, Australia is number 13, but runs the risk of being overtaken by nations with far smaller populations which offer high value added products.

We have to overcome the crippling mindset that repeats the mantra: 'But Australia is only a small economy'. Smallness has not inhibited the Swedes, the Dutch, the Finns or the Israelis.

Linkages and a National Inventory (Cadastre)

Members of the Taskforce agree that Australia is largely an information society already, but we need to go further to become a Knowledge Nation. To achieve this, we must overcome some passive, immature and under-performing elements by improving linkages.

We have invested in a very strong infrastructure but the results are often disappointing. It is as if we had trained

3 *The Chance to Change—Final Report*, November 2000 p24
<<http://www.isr.gov.au/science/review/ChanceFinal.pdf>>

FIGURE 2: Exchange Rates: US–Australian Dollar 1970–2001

TABLE 1: Characteristics of the new and old economies

Old Economy	'New Economy'
Material—resource based	Dematerialised
Physical movement	Transmission of data
Resources consumed	Data—not consumed
Energy waste = profit	Energy efficiency = profit
Generic goods (woodchips, coal, wool)	Brand name goods/services
Tonnes	Grammes
Price is central	Quality is central
Contracting market	Expanding market
Declining employment share	Rising employment share
Research significant	Research central
Was >>>Is	Is>>>Will be
Environmentally damaging	Environmentally benign
Familiar	Unfamiliar
Instrumental	Non-instrumental
Simple processes	Complex processes
Site-specific	Non site-specific
Boss-directed	Self-directed
Hierarchical	Non-hierarchical
Repetitive work	Differentiated work

pilots for the air force, but had no planes for them to fly, or trained teachers, doctors and nurses but forgot about schools, hospitals and the resources to run them well. Universities, chronically starved of funds, are forced to get out the begging bowl or rely on short-term contract work, a situation that may transform them from communities of scholars to trading corporations. This funding crisis is moving universities away from long-term research that extends the bounds of knowledge and may have valuable but unexpected effects, towards sponsored, product-oriented research, limited by the sponsor's business aims.

Many of Australia's senior biotechnologists are now working in California—probably more than are working here. In effect, we have handed California a free gift of human resources. We are capable of educating people to the highest international level, but cannot provide career structures for them. (If California were an independent nation it would have the world's fifth largest economy).

Super-specialisation within our research organisations discourages collaboration and may have contributed to the phenomenon of the disappearing public intellectual.

Much of our knowledge-generating activity leads to information being locked in silos, and there is little encouragement to use it collaboratively. Competition for external funding means universities may see each other as competitors rather than collaborators, just as it is leading to rivalry between faculties in the same institution.

Our knowledge base is strong, but our linkages are very weak, a factor compounded by the dispersed population (with electronic communication compensating only marginally for this factor).

The Knowledge Nation concept emphasises linkages.

Having a national inventory or knowledge bank—a cadastre—and making it available for public and private use would help us to understand how interdependent all sectors of our economy are, and act accordingly. We face serious environmental problems, made worse by a stubborn refusal to examine the extent of environmental damage, confusing long-term and short-term issues and exaggerating the differences between the advocates of 'environmental' issues and the agricultural and mining industries. We must emphasise how much they have in common. The economy is a wholly owned subsidiary of the environment. The environment is the totality of all there is in our world—the planet itself, soil, air, water, biota and minerals.

Some States have effective environmental registers; others do not. Creating national inventories of water, soil, wetlands, fishing, grazing areas and forests must be among the highest priorities for the Knowledge Nation, and be seen as an essential investment, not a cost.

A central pre-condition for being an effective Knowledge Nation is having an adequate knowledge base, which can then form the basis of public debate, community understanding, policy formulation and appropriate action by Commonwealth, State and Territory Governments.

Much of this material has already been collected by State Governments or by Commonwealth authorities such as the National Land and Water Resources Audit. However, the availability and quality of information is extremely variable. Some governments are extremely systematic in collecting data; others are not. As a result, it is difficult to make well-informed decisions, for example, about the long-term

viability of the fishing industry, dairying, beef cattle, forestry, and rice and cotton growing. Political sensitivity inhibits frank disclosure.

We have the technical competence, for example, with remote sensing by satellite, to conduct comprehensive surveys, to apply uniform standards and to encourage all governments to make this information accessible online, or in other published forms, generally as a public good, but charging consumers where this is justifiable. Material of extraordinary quality is held in some State offices already, but is not released for fear that the reality will generate controversy. So the truth is locked away.

The term *cadastre*, used to describe William the Conqueror's Domesday Book—a record of a detailed survey of the lands of England—could be revived as a means of distinguishing comprehensive State of the Nation reports that apply uniform standards and help make the concept of a Knowledge Nation a reality.

The cost would be modest (80 per cent of the work is already done); the benefit to the nation would be enormous.

Creating and updating the cadastre should be on the agenda for meetings of the Council of Australian Governments (CoAG), with emphasis on sharing knowledge, sharing costs and sharing benefits, for the medium and long term.

National Information and Population Policies (and The Third Age)

A national information policy will guarantee access and equity in securing knowledge as a public good, and set out the boundaries between commercial values and privacy. This will be especially important for women, ethnic minorities, people living in remote areas, and Aborigines and Torres Strait Islander peoples. Strengthening the Australian Broadcasting Corporation, the Bureau of Meteorology and CSIRO must be among the highest priorities for a Knowledge Nation.

We should adopt a national population policy, encouraging a national, rational debate about Australia's carrying capacity, and the implications for resource use, relying on an adequate database drawn from the cadastre, distinguishing population *policy* (inevitably long term) from immigration *practice* (decisions made year by year).

People are living much longer and with a shorter working lifetime. There are 2.3 million Australians who are retired but remain fit and capable—a significantly underused resource. A Knowledge Nation will recognise the significance of the 'Third Age', a growing demographic category and one that made such a major contribution, as volunteers, to the success of the Sydney Olympics.

Time budgeting and self-management of time will be central to lifelong education in a Knowledge Nation. Time is the medium in which we live: the only irreplaceable resource. Using it effectively involves setting priorities. Capacity to manage time is the major distinction between those who exercise power and those on whom it is imposed. This is a particularly significant matter for many young people who were marginalised by lack of formal education and find self-definition difficult.

Changing the culture: we have no option

Overcoming obstacles to become an effective Knowledge Nation will require leadership from government, dedication from our institutions and effort from the whole community.

It will require changing the culture. But we have no option. Time is running out.

After the Sydney 2000 Olympics, Bob Hawke pointed out how Australians had focused their efforts and co-ordinated their activities to make a success of the Games. It is a powerful illustration of what can be achieved with a national will. Even more significant was the role of the Australian Institute of Sport, which, with bipartisan support, was able to turn Bronze Medal achievers into Gold Medal winners. It took heavy investment, discipline and a strategy—and years of dedicated effort. The result was something that Australians understand and support.

Australia now faces a situation far more significant than the Olympic Games and we need to adopt a similar strategy. The challenges will be far greater, the competition far stronger, the investment cost far higher—and the penalties for failure more serious.

Significantly, the success of the Sydney Olympics did not lead to a period of basking in the euphoria of victory. Instead, it helped to focus attention and stimulate national debate on issues such as reconciliation and, unexpectedly, science. It illustrated the need for Australians to excel in things other than sport.

The central question for all radical or reformist parties ought to be: 'Apart from the economic agenda, what are human beings capable of? Do we aim at the highest common factor or the lowest common denominator?'

Can we realise, as Abraham Lincoln so memorably put it, 'The better angels of our nature?'

The technological revolution and transformation to a Knowledge Nation must be seen as an enlargement of human capacity, not a replacement. Many of our traditional supporters may find the idea intimidating and it will be our task to explain and explain and explain.

We must not confuse data with information, information with knowledge, knowledge with wisdom.

A Knowledge Nation will break down barriers. It will be inclusive, closing the disturbing gaps between the cities and the bush and between elitist and populist opinion with courage—arguing for a fresh vision of life, an updating of Ben Chifley's 'light on the hill' for the twenty-first century.

BARRY O JONES
TASKFORCE CHAIR

THE CASE FOR CHANGE

The Case for Change

Despite years of policy changes, Australia faces formidable challenges to our future prosperity.

Australia has long been a comparatively wealthy nation within the global community, providing a good standard of living for its citizens.

When most Australians think about the future, they are rightly concerned that our nation be able to continue to provide a good living standard for all our citizens in an age of great technological change and globalisation.

The Taskforce does not accept that these processes—the cause of much anxiety in Australia—must necessarily erode Australians' living standards in the years ahead. The task before us is how we equip our citizens—all our citizens—to be successful and prosperous. The first step in that process is a clear-eyed view of the challenges to Australia's prosperity this century. We achieve nothing by being needlessly alarmist or excessively complacent.

The good news is that in purely economic terms, Australia remains a wealthy nation, currently ranked 13th in the world in terms of GDP per capita.[4]

The bad news comes in three parts:

1. We are slipping behind in earning our living in the world.

2. We face a great challenge to boost Australia's productivity, and hence living standards, for the future.

3. Without prompt action our success in the world will come at the cost of a more divided society.

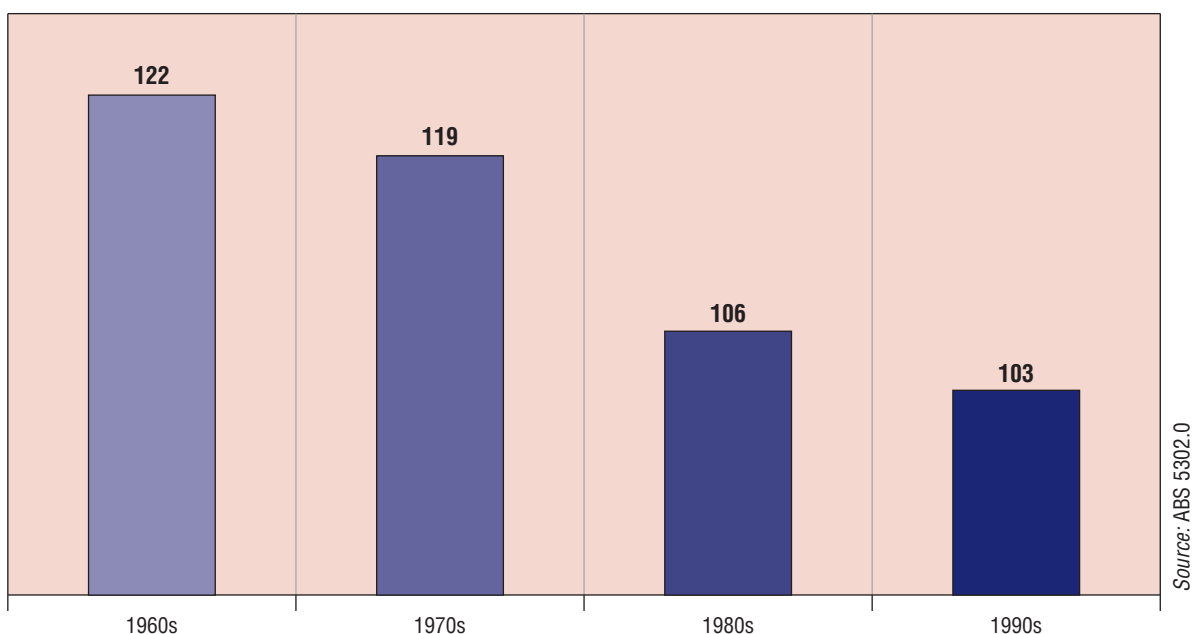**We now deal with these in turn:**

1. We are slipping behind in earning our living in the world.

International trade is important to Australia's living standards. Our export earnings boost Australian economic growth and help to fund our imports from the rest of the world. The impact of international trade on the Australian economy is illustrated by Australia's terms of trade—the average prices of our exports, divided by the average prices of our imports. Australia has suffered a long-term deterioration in our terms of trade over the past four decades, as shown in Figure 3.

Put simply, this means that Australia's export earnings cover less and less of the bill for our imported products, detracting from our total national income. This can be illustrated by adjusting GDP per capita today for the change in the terms of trade. If we enjoyed the average terms of trade of 122 in the 1960s, as shown in Figure 3, GDP would be 2.8 per cent higher than it is today, or around $900 of extra national income for every man, woman and child in Australia.

What can be done to reverse the decline in Australia's terms of trade? It is widely accepted that the reason for the decline is the shift of global trade towards higher value added goods and services, whereas Australia's exports have not undergone a commensurate transformation. Australia must therefore accelerate development of its share of global trade in emerging growth industries in ITC, environmental management and biotechnology, as well as across a range of elaborately transformed manufactures

FIGURE 3: Average terms of trade by decade[5]

Source: ABS 5302.0

4 World Bank, World Development Indicators 2000

5 Note: Index year 1998–99 = 100

(ETMs), and radically improve its performance in latent high value-added services trade, such as education and health care.

The conclusion is that to earn a better living from international trade in high value added sectors, including those of the new economy, Australia must become a Knowledge Nation.

2. We face a great challenge to boost Australia's productivity, and hence living standards, for the future.

Improving productivity—the amount of national output produced by inputs (especially labour) into the production process—is crucial to improving national living standards.

Put simply, increases in productivity are the best sustainable way of increasing living standards because they produce the extra output that can then be distributed back to those who made it, rather than relying solely on redistributing income from elsewhere within the economy.

Australia's productivity performance in recent years has been impressive. Table 2 shows labour and multifactor productivity since the 1970s.[6]

TABLE 2: Australian productivity growth rates (annual average)

	Labour Productivity	Multifactor Productivity
Second half of 1990s	3.7	2.0
1990s	2.9	1.4
1980s	1.4	0.4
1970s	2.8	1.3
Average since 1964/65	2.4	1.1

Source: ABS 5204.0

In its recent review of Australia's productivity performance, the Productivity Commission concluded that this improved performance was the result of microeconomic and labour market reforms during the 1980s and 1990s.[7]

Interestingly, the Productivity Commission also concludes that this productivity acceleration has not been due to the take-up of new technologies.[8]

A key benchmark for productivity is the United States, driven in particular by the fact that United States living standards (GDP per capita) are more than 50 per cent above Australian levels.[9] In this case, the comparison is less encouraging. As Table 3 shows, Australia has closed the (labour) productivity gap with the world's leading economy more slowly than all but five of the 22 OECD countries listed.[10]

So where is the next big productivity boost to originate that will allow Australia to bridge the productivity (and hence living standards) gap with the leading global economies?

The Taskforce argues that while additional economic reforms such as those of the 1980s and 1990s can and will further improve Australian productivity, the great productivity gains in the future will flow from investing in human capital, innovating in industries, and embracing new technologies.

This conclusion is supported by the findings of a recent two-year OECD study into the drivers of economic growth for the future:[11]

> In the long term, growth depends on building and maintaining an environment that is conducive to innovation and the application of new technologies. This involves ensuring the generation of new knowledge, making public investment in innovation more effective, improving interaction between universities, research institutes and firms, and establishing the right incentives for innovation.[12]

And

> Investing in human capital is good for growth, especially in the context of rapid technological change: for ICT to be used effectively and the benefits of new technology to materialise, the right skills and competencies must be in place.[13]

The conclusion is that Australia must become a Knowledge Nation to improve the productivity and, therefore, the living standards of our people.

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6   Labour productivity is simply output per hour worked. Multifactor productivity measures the efficiency with which both capital and labour inputs are used in the economy.

7   Productivity Commission (19 June 1999) *The New Economy? A new look at Australia's productivity performance*

8   Note, however, that recent (and heavily qualified) research from the Reserve Bank of Australia (David Gruen 'Australia's Strong Productivity Growth: Will it be Sustained?' *Reserve Bank of Australia Bulletin*, February 2001) does suggest the use of IT was a significant factor in Australia's productivity growth during the 1990s.

9   In $US at Purchasing Power Parity (1998). *Source:* United Nations Conference on Trade and Development (UNCTAD) *Handbook of Statistics* Table 6.1

10   These labour productivity figures were prepared on a Purchasing Power Parity basis

11   OECD (2001) *The New Economy: Beyond the Hype 1—Final Report on the OECD Growth Project* OECD.
      http://www.oecd.org//subject/MCM/2001/products/0001321e.pdf

12   ibid, p1

13   ibid, p13

TABLE 3: Productivity levels in OECD countries, 1950–98
(GDP per man-hour relative to the United States)

	1950	1960	1973	1987	1992	1998
United States	100	100	100	100	100	100
Japan	15	20	45	60	67	68
West Germany	34	52	73	91	100	106
Germany				—	87	90
France	42	51	74	99	101	102
Italy	38	46	78	96	97	100
United Kingdom	58	57	68	81	79	82
Canada	68	72	75	83	82	80
Australia	66	68	69	77	75	78
Belgium	50	53	76	102	108	109
Denmark	54	58	79	85	85	89
Finland	32	37	59	69	74	82
Greece	19	n.a.	43	55	54	54
Ireland	32	n.a.	46	66	77	86
Korea	11	n.a.	15	25	32	36
Mexico	35	n.a.	47	n.a.	41	34
Netherlands	49	57	82	98	107	98
Norway	51	n.a.	71	96	104	109
Portugal	20	n.a.	42	44	48	50
Spain	24	n.a.	53	79	80	79
Sweden	50	55	78	84	82	84
Switzerland	70	74	84	85	87	85
Coeff. of variation'	50	n.a.	30	26	25	24

1 Excluding Mexico and Germany.

Source: OECD estimates.

3. Without prompt action our success in the world will come at the cost of a more divided society.

The Taskforce believes it is morally unacceptable for the benefits of economic growth to go disproportionately to the few.

History teaches us very clearly what happens if change and reform are not in the interest of the majority of people. A recent book, *Globalisation and History: the Evolution of a Nineteenth Century Atlantic Economy*, disproves the popular belief that the globalisation of the early part of the 20th century was brought undone by the First World War. It was brought undone by a popular backlash against globalisation before the First World War.[14]

The same point was well made by *The Economist*, which stated in a recent editorial:

> International economic integration is not an ineluctable process ... it is only one, the best, of many possible futures for the world economy ... [G]overnments, and through them their electorates, will have a far bigger say in deciding this future than most people appear to think. The protestors are right that governments and companies—if only they can be moved by the force of argument, or just by force—have it within their power to slow and even reverse the economic trends of the past 20 years.[15]

In this context, a report by the National Centre for Social and Economic Modelling makes sobering reading.[16]

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14 KH O'Rourke and JG Richardson (1999), *Globalization and History: The Evolution of a Nineteenth-Century Atlantic Economy.* MIT Press

15 The Case for Globalisation, *The Economist*, 21 September 2000

16 A King (May 1999), *Trends in the Distribution of Australian Incomes*, National Centre for Social and Economic Modelling

Analysing income distribution trends between 1982 and 1993–4, the report concludes that:

> Falls in real earnings are shown for those in the lower part of the income distribution; substantial increases are shown for those in the upper parts ... This spreading of market incomes can be seen as the result of developments such as Australia's changing economic structure, globalisation, and changes in industrial relations.

Over the period 1982 to 1993, Australia shared this phenomenon of increasing inequality of market incomes with most other developed nations. However, the report goes on to note:

> What might come as a surprise is ... that, despite a marked increase in the inequality of market incomes, there has been relatively little change in the overall distribution of total after-tax income. The main reason for this is that developments in social security—real increases in many payments, substantial increases in family payments and rent assistance—have largely countered the increasing inequality of market incomes.[17]

In this, Australia stood out against an international trend. This is a laudable achievement, but the concern must be that a government without a similar commitment to social justice will allow these underlying inequalities to emerge.

The Taskforce believes that the job for government in the century ahead will be to attack the root causes of inequality in market incomes as well.

There has been much argument that globalisation has led to a decline in low-skill wages (in developed nations) relative to high-skill workers. There is little empirical evidence for this in Australia. However, a recent study by the Economic Planning and Advisory Council (EPAC) indicated the significant returns to high-skilled workers, in the form of higher employment growth, as indicated by Table 4.[18]

This supports what most Australians understand intuitively—that higher skills are the road to more secure employment in the modern Australian economy.

The conclusion is that Australia must become a Knowledge Nation, investing in the education and training of all its citizens, to give each a secure and prosperous place in the modern Australian economy.

Taken together, these three elements of improving our international trade performance; boosting our national productivity; and bridging the skill, employment and income gaps in our society, illustrate briefly the Taskforce's case for a radical change towards making Australia a Knowledge Nation.

The next task is to describe how Australia is performing in creating a Knowledge Nation compared to other countries.

TABLE 4: Wages and employment growth by occupational group (%)

By skill level of occupation	Nominal Wages (1986–1995)	Employment (1986–1994)
High	58	24
Middle	52	0
Low	55	2

Source: EPAC (1996)

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17 'The Case for Globalisation', *The Economist*, 21 September 2000

18 Economic Planning and Advisory Commission (EPAC) (1996) *Future Labour Market Issues for Australia*; EPAC Paper # 12; AGPS

AUSTRALIA—AN UNDER PERFORMING KNOWLEDGE NATION

While Australia in some ways on the path to becoming a Knowledge Nation already, it is an under-performing one.

In all the key areas of investment we are falling behind our major competitors.

We are in danger of becoming a nation of followers, not creators.

This section outlines the extent of the problem in the vital areas of investment in education and skill formation, public and private sector R&D, and commercialisation. It finishes with an appraisal of Australia's performance in selected knowledge-intensive industry sectors. The section that follows outlines what needs to be done to reverse this decline and make Australia an effective Knowledge Nation.

The Knowledge Investment Crisis

Considine, Marginson, Sheehan and Kumnick have constructed for the Taskforce an index of Australia's investment in knowledge between 1985 and 1998 (see Table 5).[19] The index is based on the latest OECD data and compares Australia to 11 other OECD countries. It measures spending on both the creation and application of knowledge, including public spending on R&D and software, and the development of knowledge capabilities of individuals, including spending on education and training.

This measure shows that as well as being at the lower end of the range of OECD countries in 1995, investment in knowledge in Australia has fallen further since then relative to international trends (see Figure 4). While investment in knowledge in the selected countries increased from 7.46 per cent of GDP in 1985 to 8.22 per cent in 1998, investment in knowledge in Australia fell from 6.47 per cent of GDP to 6.15 per cent. And while it increased from 7.90 per cent to 8.22 per cent in the selected countries between 1995 and 1998, in Australia, spending took an upward swing in 1996, after which it collapsed. In the United States, investment in knowledge increased from 8.39 per cent of GDP to 8.73 per cent over the same period. In 1998, Australia was about 25 per cent lower in terms of investment in knowledge than the weighted average of the 12 countries, and nearly 30 per cent lower than the United States. Given the role of the United States as a pacesetter in economic change, this comparison is

particularly important, and the widening gap particularly disturbing. On this measure, the share of the United States GDP devoted to investment in knowledge rose by just on 15 per cent between 1985 and 1998, and by 4 per cent between 1996 and 1998. By contrast, Australian investment fell by 5 per cent between 1985 and 1998, with about half that fall after 1996.

Furthermore, the ratio between investment in knowledge and investment in fixed capital assets is trending downwards (see Table 6). This confirms that the economic period after 1996 was associated with a massive diversion of national investment into buildings, rather than knowledge. *To this extent, it represents a wasted opportunity that must be addressed in the first decade of the new century*.

These data show that *Australia is facing what amounts to a crisis in Knowledge Nation investment*. The Taskforce also believes that when data for the past three years become available, they will show that this gap in knowledge investment between Australia and other nations will have widened further. While other nations are moving ahead with public and private investment in R&D and education, Australia is still pursuing cost cutting and privatisation policies.
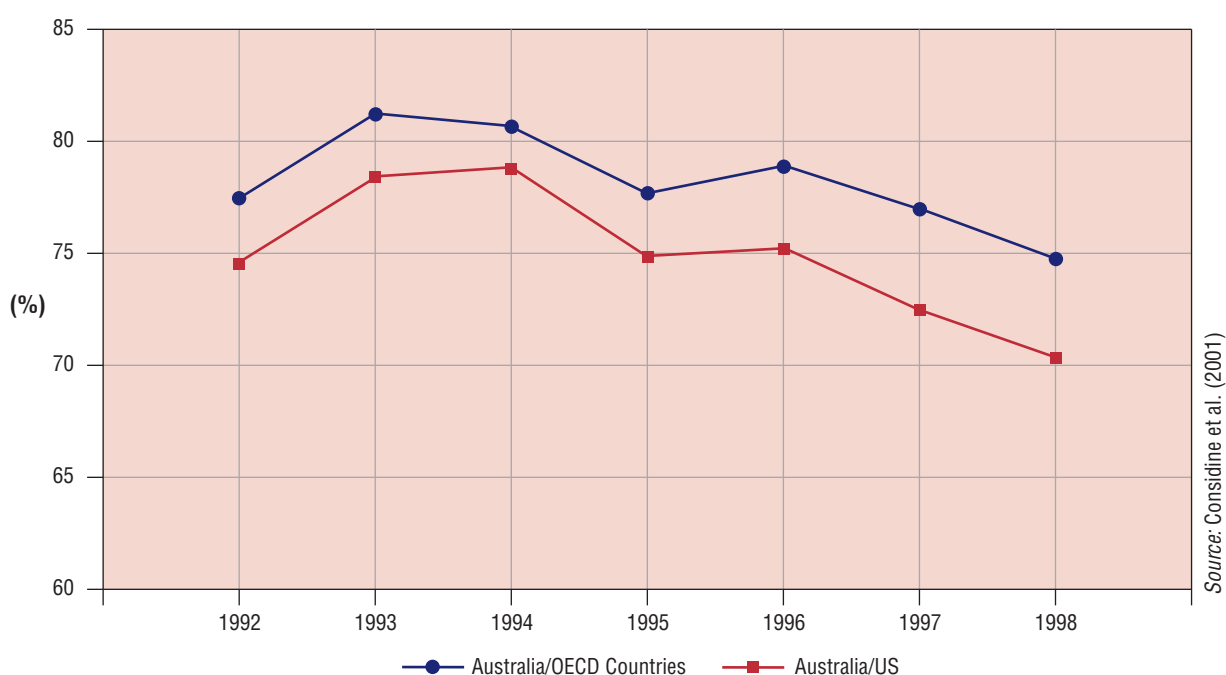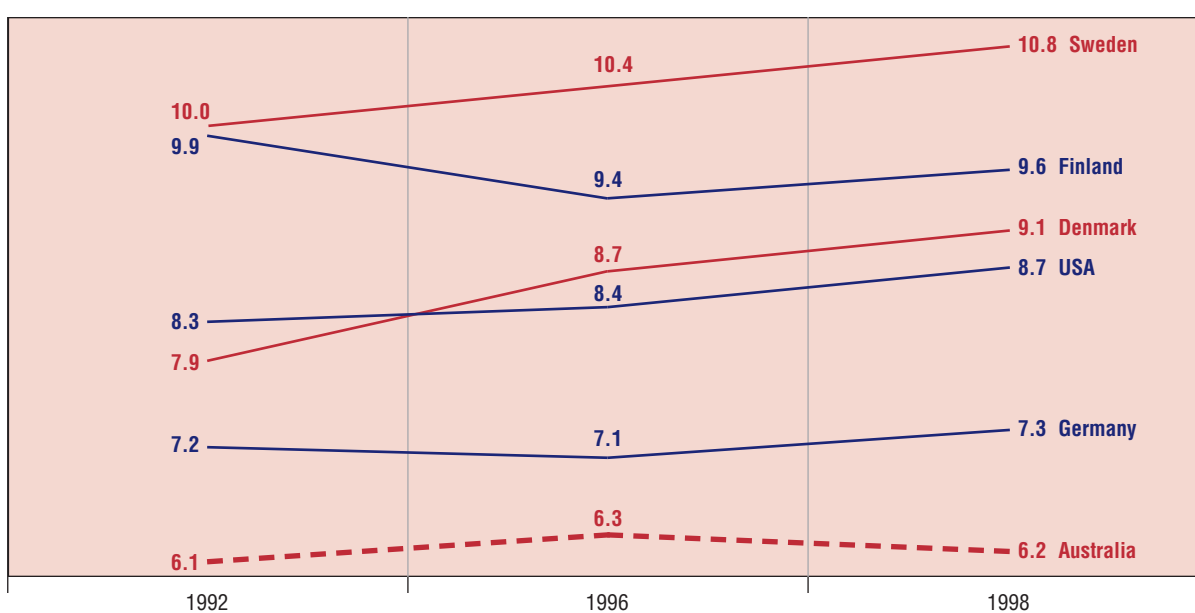
Figure 5, which is drawn from Table 5, illustrates the seriousness of this problem. *Australia is falling behind other nations in investment in knowledge creation. Unless this is rectified, we are in danger of losing touch forever with the world's leading nations*.

TABLE 5: Investment in knowledge, selected countries, 1985–1998 (% of GDP)

		1985	1992	1993	1994	1995	1996	1997	1998
1	Sweden	8.72	9.97	10.00	10.00	10.15	10.39	10.59	10.83
2	France	7.05	7.95	8.17	8.18	8.41	8.40	8.32	8.38
3	Denmark	7.47	7.92	8.58	8.39	8.46	8.73	8.84	9.06
4	Finland	7.29	9.93	9.57	9.00	9.11	9.41	9.26	9.62
5	Norway	6.64	8.86	8.82	8.92	8.90	7.97	8.67	8.80
6	Canada	7.52	8.55	8.10	7.94	7.58	7.41	7.25	7.38
7	UK	7.18	7.16	7.08	7.05	7.11	7.03	6.81	6.79
8	USA	7.60	8.26	8.16	7.86	8.17	8.39	8.63	8.73
9	Netherlands	8.31	7.02	7.09	7.00	6.92	6.88	6.78	6.95
	Austria	6.87	7.32	7.07	7.12	7.10	6.96	7.88	8.03
	Germany	7.26	7.19	7.09	6.97	7.07	7.13	7.11	7.27
	Australia	6.47	6.14	6.42	6.22	6.11	6.30	6.24	6.15
Weighted average		**7.46**	**7.96**	**7.90**	**7.71**	**7.90**	**8.00**	**8.12**	**8.22**

Source: Considine et al. (2001)

19 M Considine, S Marginson, P Sheehan and M Kumnick (2001) *The Comparative Performance of Australia as a Knowledge Nation*, Chifley Research Centre

FIGURE 4: Investment in knowledge: Australia's comparative performance

Source: Considine et al. (2001)

FIGURE 5: Investment in knowledge: selected countries (% of GDP)

TABLE 6: Investment in knowledge and private investment on buildings and structures, Australia 1992–1999 (% of GDP)

	1991–2	1992–3	1993–4	1994–5	1995–6	1996–7	1997–8	1998–9
Private investment in buildings and structures	7.4	7.4	7.9	8.1	7.8	8.2	9.1	9.4
Investment in knowledge	6.14	6.42	6.22	6.11	6.30	6.24	6.15	n.a.
Ratio of investment in knowledge to investment in buildings and structures	83.0	86.8	78.8	75.4	80.8	76.0	67.6	n.a.

Source: Considine et al. (2001)

An Under-performing Education System

Comparative performance

Australia's performance in education is falling behind compared to our main competitor nations. Our history is one of significant achievement up to the 1990s, followed by decline, especially after 1995.[20]

■ Between 1996 and 1998, preschool participation in Australia declined from 24.1 per cent to 22.4 per cent, compared to the OECD country average of 39.6 per cent, and much higher levels of participation in Western Europe.

■ While Year 12 completion rates in Australian schools increased from 36.3 per cent in 1982 to 77.1 per cent in 1992, this increase has not been sustained and has been stagnating for a number of years. In 2000, the apparent retention rate for full-time secondary students from Year 7/8 to Year 12 was only 72.3 per cent. The decline in participation was sharper for boys than for girls, for children from State schools, and for those from lower socio-economic backgrounds.

■ While there was growth in the numbers of Australians going to university in the 1990s, this was at a slower rate than the expansion of university places in most OECD countries. Between 1990 and 1995, domestic student load (i.e. the number of effective full-time students) in Australian universities rose by 19.2 per cent, but in the next four years to 1999, the rate of increase was slower, at just 10.2 per cent. *In the year 2000, the number of domestic students in Australian higher education system actually fell, from 603,156 in 1999 to 599,905 in 2000 (a decline of 0.5 per cent). This is a very worrying trend.*

■ Of the Australian population aged 25–64 years, 18 per cent have a tertiary education. While this is above the OECD average, it is well behind the United States at 27 per cent.

Education funding levels

Since 1996, education policy in Australia has been dominated by the drive to reduce fiscal costs. This has been at the expense of national capacity. Once an above-average investor in education, Australia is now below the OECD average (with 5.46 per cent of GDP devoted to education of all forms, compared to an OECD country average mean of 5.66 per cent in 1998). In terms of public expenditure on education at all levels, Australia's 4.34 per cent in 1998 was well below the OECD average of 5.00 per

cent and ranked 21st out of 29 OECD countries. The United States (4.82 per cent), Canada (5.48 per cent) and the United Kingdom (4.65 per cent) were all higher.

■ Preschool funding is lamentable by international standards. In 1998, Australia spent only 0.1 per cent of GDP on pre-primary education, compared to an OECD overall mean of 0.4 per cent, the same as the United States.

■ Total public spending on schools in Australia by the Commonwealth and the States (3.8 per cent in 1998) was only just above that of the OECD average (3.71 per cent), but well below that of high investors such as Korea and France. Commonwealth policy evidences a lop-sided preference for private schooling, increasingly at the expense of the public sector although it educates more than two-thirds of all students. This has been responsible for the non-government sector pulling ahead in terms of Year 12 retention and results.

■ While university income from private sources (Higher Education Contribution Scheme [HECS], international student fees, domestic student fees, donations and endowments, investments and fee-for-service research) has increased markedly as a proportion of total university funding since 1996, this has been needed to replace significant falls in Commonwealth funding. In 1998, Commonwealth funding constituted only 51.85 per cent of total university funding, down from 58.08 per cent in 1996. Overall, total university income has stagnated at a time Australia needs it to expand. Worryingly, the evidence suggests that in terms of the teaching and research functions of universities, the increased private income per student has not necessarily substituted for the public income per student that has been lost, but has been ploughed back into the corporate functions of universities (such as off-shore marketing, public relations, ICT and asset management). Overall, funding per student is falling (now $29,194) and is now well below the OECD average ($35,087).

■ Cutbacks in Commonwealth funding of vocational education and training (VET) have been even more severe than for universities. This has been compounded by the lesser ability of VET institutions to raise private income compared to universities. Between 1990–91 and 1997–98, government expenditure per course hour in VET declined by 17.3 per cent in real terms. The National Centre for Vocational Education Research calculates that this fell by a further 11.0 per cent in the two years between 1997 and 1999.

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20 The following analysis is drawn from ABS 4221.0; *OECD Education at a Glance 2001; The Comparative performance of Australia as a Knowledge Nation*

The consequences for quality

What have been the implications of this lack of adequate Commonwealth funding of education?

■ In the VET sector, the dramatic funding shortfalls are unsustainable in the medium term. Government policy is making it harder for VET institutions to fulfil their roles in building a knowledge economy, such as the diffusion of new technologies, techniques and modes of work organisation, and industry retraining. Anecdotal evidence suggests that some institutions are struggling to remain open.

■ There have been large increases in university student:staff ratios (i.e. effective full-time staff to full-time students in teaching-related positions) from 1:15.31 in 1996 to 1:18.84 in 2000. Increases have been across the board, affecting all disciplines.

■ The proportion of university teaching staff employed as casuals rose from 17.49 per cent in 1990 to 19.35 per cent in 1998.

■ The proportion of university staff employed in teaching fell from 42.79 per cent in 1990 to 37.68 per cent in 1998.

■ The major growth in university enrolments has been in business, economics and administration. It has been driven largely by the need for cash-strapped universities to seek full-fee paying overseas students. Growth in other important disciplines has been disappointing.

■ What are in effect big increases in HECS payments through rate rises and falls in the repayment threshold have acted as a disincentive for many people, particularly mature-aged people, from entering university. Evidence suggests that inadequate levels of income support are affecting the participation rate of young people from working class backgrounds in higher education.[21]

■ The remuneration of Australian teachers and university lecturers compared to their overseas counterparts is low. While Australian teachers generally have high starting salaries, they can expect to earn substantially less than their counterparts in most comparable nations as their career continues. Similarly, Australian university teaching salaries at all levels are approximately only 65 per cent of their counterparts in the United States.

The implications of this are worrying. The decline in job security and expected income and the increase in student load per lecturer are acting as disincentives for young people considering a research career in Australia. The impact is severe in areas closely associated with high technology enhancement and research. The dramatic increase in student:staff ratios must inevitably affect teaching quality, particularly the small group and one-on-one teaching that is the hallmark of good university experience.

Furthermore, while the substantial increase in the number of international students has been positive for the Australian economy and universities, the increasingly lop-sided nature of enrolments in coursework masters degrees and business studies has potentially negative implications. Such growth has been at the expense of disciplines that have a greater capacity to contribute directly to the growth of a Knowledge Nation, such as science, mathematics, engineering, education, humanities and the social sciences. Fiscal pressures should not be allowed to distort the growth of Australia's higher education sector in this way. The Taskforce believes that there is a need for greater Commonwealth involvement in optimising the benefits to Australia of the growing numbers of overseas students in our universities.

Critical gaps in Australia's educational capacity are now opening up.

■ There is a crisis throughout the mathematical sciences, including a 25 per cent fall in the number of university mathematics staff since 1995, a decline in the number of Year 12 students studying advanced mathematical courses, and shortages of well-qualified maths teachers. It has been estimated that about 40 per cent of junior secondary students are taught mathematics by a teacher who has little or no background in the discipline. Some schools, especially those in regional and rural areas, simply cannot find qualified maths and science teachers.[22]

■ Although improving, Australia is only in the middle rank of performance in international comparisons of literacy and numeracy. We need to be at the top.

■ There is a looming teacher shortage that must be addressed, particularly in rural areas.[23]

■ Australia faces a serious shortage of skilled ICT workers over the coming years.[24]

■ Options for lifelong learning and retraining are being cut off for many people.

21 B Birrell, A Calderton, IR Dobson and TF Smith. 'Equity and access to higher education revisited', *People and Place*, Vol.8, No. 1, 2000

22 J Thomas, 'Mathematical Sciences in Australia: Looking for a Future', *FASTS Occasional Papers Series*, Number 3, October 2000

23 B Preston (2000) *Teacher supply and demand to 2005: projections and context*, Australian Council of Deans of Education, Canberra

24 IT&T Skills Taskforce (1999) *Future Demand for IT&T Skills in Australia 1999–2004*. Available at http://www.aiia.com.au/activities/index.html

The Crisis in Australia's R&D Performance

The establishment of 'emerging' industries and enabling industries holds great promise for creating new highly-paid jobs, increasing national wealth and its distribution, improving health standards through medical and public health research and ensuring environmental sustainability.

As the Chief Scientist stated recently, the next few years represent a window of opportunity for Australia to maximise the benefits of investment in the creation of emerging industries, after which rates of return and benefits will be diminished.[25] *Creating emerging industries will require a sense of urgency and purpose that is currently lacking.*
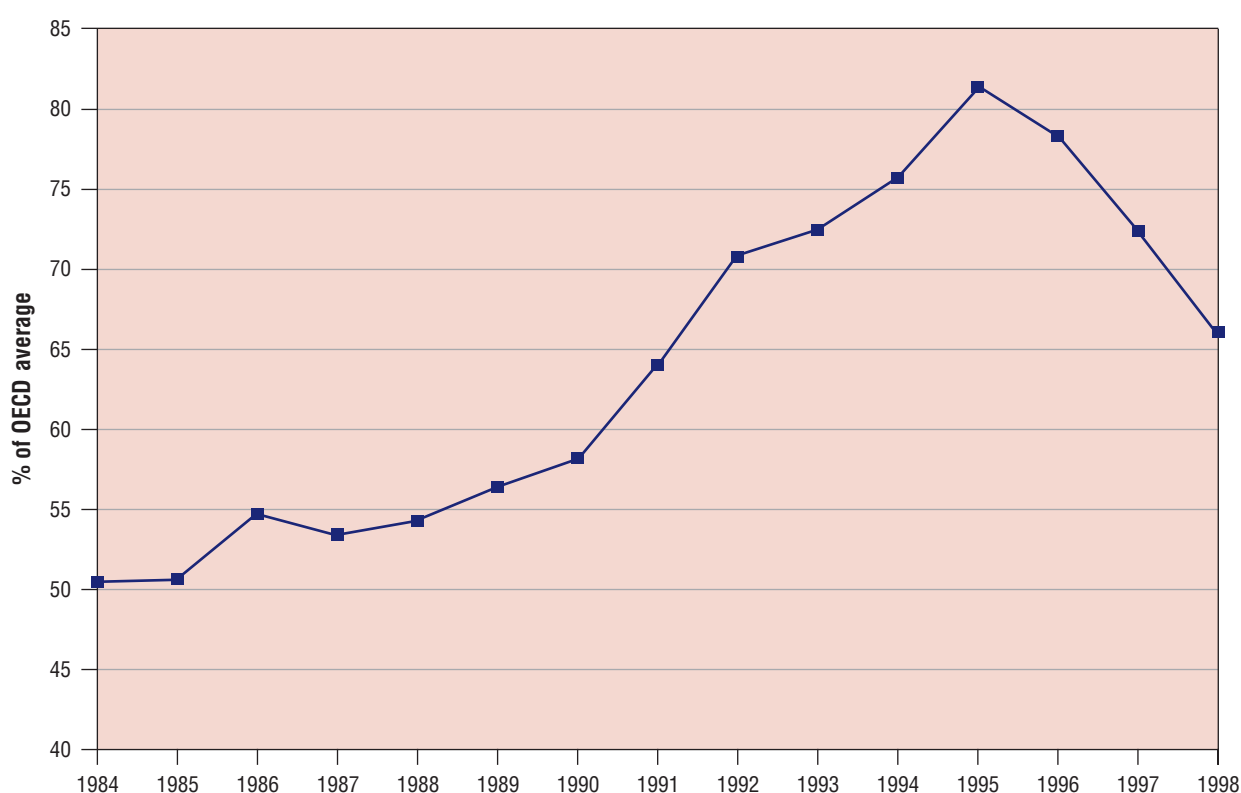
The first problem to overcome is Australia's woeful R&D performance. *Between 1996–97 and 1998–99, R&D as a share of GDP declined from 1.65 per cent to 1.49 per cent—a fall of 10 per cent of the nation's income devoted to R&D*. Both the private and public sectors were

responsible for this fall. Business expenditure on research and development fell from 0.80 to 0.67 per cent of GDP, and government expenditure on research and development fell from 0.39 per cent of GDP to 0.35 per cent (not including university R&D) (see Figure 6).

In comparative terms, Australia's R&D performance improved significantly between 1984 and 1996 but began to tail off significantly thereafter. Since 1995, Australian R&D has fallen by 15.4 per cent as a share of GDP, whereas that of the OECD and the United States has increased by 4.2 per cent and 5.0 per cent respectively (see Table 7). The share of GDP devoted to R&D in Australia has fallen from 81.6 per cent of the OECD share in 1995 to 66.6 per cent in 1998.

The Taskforce believes that Australia must become a world leader in the percentage of GDP devoted to R&D. It notes, however, that even at a much higher level of R&D to GDP, the small size of the Australian economy means that the overall quantum of R&D will be comparatively low in world terms, necessitating greater targeting of our R&D effort.

FIGURE 6: Australian R&D spending (as a share of GDP), as a proportion of total OECD spending levels

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25 *The Chance to Change: Discussion Paper by the Chief Scientist*, August 2000, p19

TABLE 7: Investment in R&D, Australia and selected OECD countries, 1992–98, (share of GDP)

	1984	1991	1992	1993	1994	1995	1996	1997	1998	1984–95	1995–98
										change (%)	
OECD	2.20	2.28	2.24	2.19	2.14	2.16	2.18	2.21	2.25	−1.8	4.2
Australia	1.11	1.46	1.59	1.59	1.62	1.76	1.70	1.60	1.49	59.0	−15.4
USA	2.73	2.81	2.74	2.62	2.52	2.61	2.66	2.71	2.74	−4.4	5.0

Source: OECD Main Science and Technology Indicators (2000) and estimates by Considine et al.

Venture Capital and Commercialisation

One of the major impediments to the growth of new Australian firms in the knowledge area is the relative lack of venture capital funds and other forms of support for start-up companies, such as incubator and other clustering arrangements, compared to other competitor nations.

The stories of the great Australian inventions that had to go overseas to be brought to market are depressingly familiar to all Australians. A recent MIT study listed the world's 150 leading companies across eight key high-tech sectors according to the number of a firm's patents and other indicators that combine to measure their capacity for innovation. The key sectors are aerospace, automotive, biotechnology/pharmaceuticals, chemicals, computers, electrical/electronics, semiconductors and telecommunications. Worryingly, there are no Australian companies in the list, but there are many from countries with populations that are similar to or smaller than Australia's, such as Canada, Denmark, Finland, France, the Netherlands, Singapore and Sweden.[26] This suggests powerfully that we need to increase the rate of commercialisation of Australia's research efforts.

It is true that in many cases, Australia's small domestic market leaves entrepreneurs with little choice but to commercialise their ideas overseas. However, if Australia is to become a Knowledge Nation, it will be incumbent upon future Australian governments to ensure that there are no excuses for Australia to miss out on the jobs and profits that flow from the successful commercialisation of brilliant Australian ideas.

A number of policy innovations in recent years (such as Pooled Development Funds and capital gains tax incentives) have made progress towards improving Australia's commercialisation environment. Nevertheless, more work remains to be done. For example, the recent Chief Scientist's report concluded that:

It appears that after a number of false dawns, Australia does seem to be solving the long-standing venture capital problem ... however the emerging issue has become the inadequacy of pre-seed capital and the "deal" flow—that is, where do marketable ideas come from?[27]

Details of recent initiatives and recommendations have been set out in the reports of the Chief Scientist and the Innovation Summit Implementation Group.[28] The Taskforce supports these recommendations. Australia also needs to address the tax and other impediments that are limiting our ability to commercialise research and development and attract large companies here. This report lists several recommendations to improve Australia's venture capital and commercialisation performance (see Recommendations 4–7 in particular).

Investment in Information and Communication Technology

Information industries are both key drivers of the global knowledge economy and central sources of growth in modern economies. The Australian Treasury has recently argued that Australia's failure to develop an indigenous ICT manufacturing sector is of no consequence; that the only benefit of ICT is its diffusion throughout the whole economy and the increase in labour productivity it brings.[29] The Taskforce disagrees. We believe that the impact of ICT occurs through two main channels—the rapid adoption and use of information technology goods and services across all industries, *and* the rapid growth in output and employment in the information industries themselves. While we acknowledge the need to encourage the embedding of new processes such as ICT (and also biotechnology and sustainability, among others) in all relevant industries, we believe that Australia must reject the mentality that sees us content to send our best ideas and minds overseas to be developed and commercialised.

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26 http//www.technologyreview.com/magazine/may01/scorecard.asp

27 *The Chance to Change Final Report*, p82

28 *The Chance to Change: Final Report, pp.81–98; Innovation Unlocking the Future: Final Report of the Innovation Summit Implementation Group*, 2000, pp.22–3

29 Budget Paper No. 1, 2001–02, statement 4

Consigning Australia's economic future to that of just being a good diffuser of technology merely reflects a poor understanding of the nature of technological change. It is increasingly becoming accepted that the productivity jumps associated with the new economy have been most visible in those sectors that heavily use new technology and also those sectors engaged in the production of new technology. The economic and knowledge spillovers from use and production overwhelm those associated with just being a good diffuser.

It is important to recognise that the production and use of new technology are not mutually exclusive but, rather, are mutually re-inforcing. It is one of the great economic fallacies that being a good adopter of technology is both costless and easy. The economics literature on growth suggests otherwise. The essential economic requirement in the new economy—for being a good adopter, a good user, and a good producer—is for economies to be lifted close to their knowledge frontier. Critical to that objective is the need to build a culture based on education, skills, training, research and development and innovation. This is not derived through some exogenous means, but must be generated endogenously in the economy and our society.

In an increasingly globalised and competitive market, it is clear than economies that position themselves close to the frontier of knowledge are best able to exploit the discoveries of others and, at times, lead other economies in the reaping the economic rents of leading innovation. While it is often argued that to always be a leader can be associated with large costs, to never be a leader can also generate opportunity costs.

Developing a production sector in ICT is fundamentally about value-adding to our existing industries, developing new products and processes, and, importantly, developing our content generation and services sector.

In Australia, it has generally been accepted that, in spite of having failed to develop a major role in the creation and production of ICT goods and services, the nation is relatively well advanced in other information industries and in the application of ICT goods and services in businesses generally. Thus the information industries should provide a strong impetus to growth in Australia also. Drawing on the work of Houghton,[30] research by Considine, et al. on behalf of the Taskforce[31] shows that, over the past few years, this seems not to have been the case:

■ Australia's position in the communication and information equipment area, which had been relatively small but growing, has declined significantly in recent years.

■ In spite of the importance of the information industries, and their strong growth globally, employment in Australia in these industries has barely increased at all since 1995–96, and employment in ICT specialist businesses has fallen.

■ While the number of firms engaged in these industries has continued to grow, that growth has been slower since 1995–96 than was the case for the previous three years, and has largely comprised an increase in the number of very small firms.

■ In terms of spending on the ICT industries, Australia rates relatively highly among OECD countries, although in part this is due to the impact of distance on spending on telecommunications infrastructure.

■ The overall market for the products and services of the information industries continued to grow strongly in Australia, with the total market estimated at about $75 billion in 2000. *But the share of domestic production in total income from those sales declined sharply between 1995–96 and 1998–99.*

■ *More generally, in terms of the contribution of the information industries to the national economy, Australia ranks last of the 18 OECD countries for which information is available.*

One of the most striking of these findings is in terms of employment in the information industries, data on which are provided in Table 8. After growing by 42.5 per cent between 1992–93 and 1995–96, employment in these industries increased by only 0.3 per cent in the three years to 1998–99. This cessation of growth reflects two main factors: a big decline (18.8 per cent) in employment in the communications services industries, as service providers cut back sharply on staff levels, and a smaller decline in the manufacturing and wholesale area (3.9 per cent). While the information services and content areas continued to grow by 35.2 per cent and 12.1 per cent respectively, this growth barely offset the declines in the other two areas. Specialist ICT businesses make up about 80 per cent of total employment in the information industries, and in these businesses employment actually fell by about 2,500 persons between 1995–96 and 1998–99.

This weakness in employment in the information industries after 1995–96 is in turn related to trends in the number of businesses active in these industries. The overall number of businesses operating in the information industries continued to rise after 1995–96, increasing by 30.4 per cent between 1995–96 and 1998–99. However, the overwhelming share of the additional jobs was in the information services sector, and jobs in the manufacturing and wholesale sector fell by 20.7 per cent.

30 J Houghton (2001) *Information Industries Update 2001*, Centre for Strategic Economic Studies, Victoria University, Melbourne

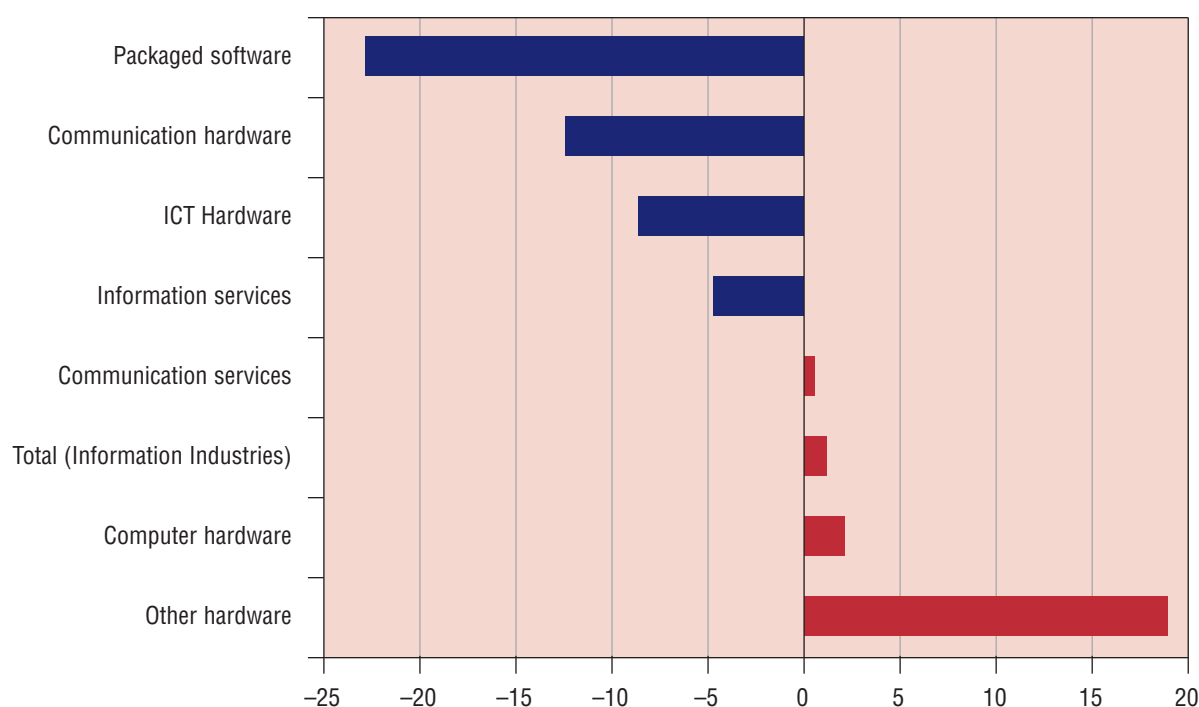31 Considine et al. op. cit, pp.35–9

TABLE 8: Employment in the information industries, 1992–93 to 1998–99

	1992–93 no.	1995–96 no.	1998–99 no.	Share 1998–99 (%)	Growth 1992–3 to 1998–9 (%)
Communication services	68,000	91,701	74,467	30.3	9.5
Information services	30,071	55,028	74,395	30.3	147.4
Manufacturing & wholesale	60,613	83,208	79,931	32.5	31.9
Information content	13,308	15,155	16,982	6.9	27.6
Total	**171,992**	**245,092**	**245,775**	**100.0**	**42.9**

Source: Houghton (2001), based on ABS sources.

More important, perhaps, is the change in the number of firms in the information industries by size. Between 1995–96 and 1998–99, the number of medium–sized firms (20–99 employees) actually fell, and there was only a small increase in large firms. Apart from this, all of the increase in the number of firms was in those with fewer than 20 employees. These increased by 4,530 firms or 35.4 per cent. Small firms operating in information services now account for a dominant share of the Australian information industries.

It is likely that an industry that consists primarily of small firms operating in the information services area will not be able to compete effectively with the large international companies that play such a decisive role globally. In fact, one of the most disturbing trends of the period since 1995–96 has been the falling share of the large Australian market that has been met by Australian providers. As shown in Figure 7, *the share of domestic production in total income from Australian sales has fallen sharply for the packaged software and communications and ICT hardware markets.*

FIGURE 7: Change in the share of domestic production in total income from sales by sector, 1995–96 to 1998–99 (%)

Note: ICT Hardware is the sum of communication hardware, computer hardware and other hardware.

Source: CSES analysis.

As Houghton concludes: 'it appears that Australia's information industries are failing to hold their own against competition from overseas products'.[32] The communications and information services are still much less exposed to global competition than the product industries, although that competition is intensifying rapidly.

This weakening trend in Australia's information industries belies the widely held belief that in this area, Australia is coping reasonably well with the emergence of the global knowledge economy. Indeed, comparative data on the share of value added of the ICT industries in total business sector value added (Figure 8) illustrate starkly the limitations of these industries in Australia. Of the 18 OECD countries for which data are available, Australia has the smallest share of ICT value added of any country. The information industries may be growing rapidly around the world, but Australia's position within them is small and seems to be declining in relative terms.

The common factor in this is the impact of government policies, particularly the failed ICT outsourcing program. This has retarded the development of a promising Australian ICT industry and constrained the growth of large firms that could have developed an Australian 'brand name'.
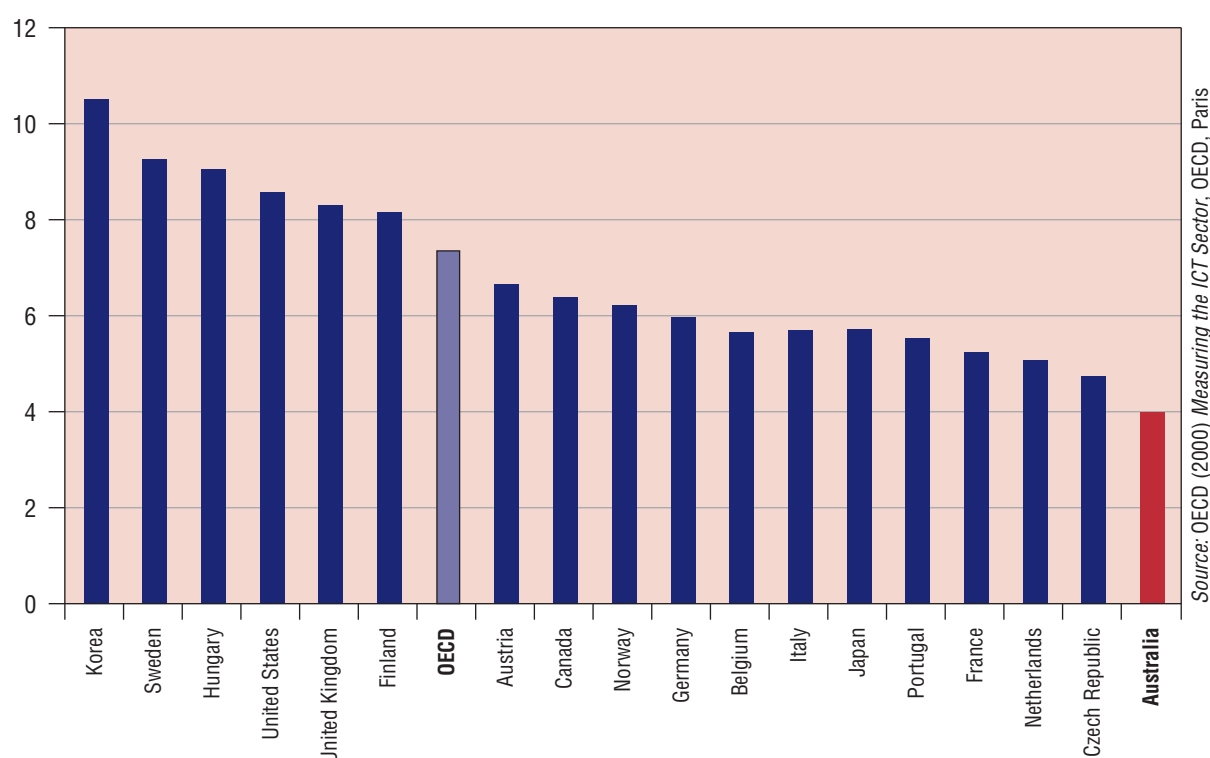
Investment in Environmental Management Technologies and Services

A key source of opportunity for Australia is the growing world market for environmental management technologies and services.

It has been estimated that in 2000, the world environment market was approximately $1 trillion, including water, waste, air quality, pollution control, recycling, impact assessment and conservation services. However, as virtually every business has an environmental responsibility, the real market for environmental products and services is the whole economy. Around the world, firms are responding to the lack of government leadership by adopting their own environmental standards, particularly 'triple bottom line' (financial, social and environmental) reporting. With the narrowly defined environmental market expected to grow much faster than the broader economy, the opportunities for Australia to benefit both environmentally and economically are enormous.

Unfortunately, while Australia has much expertise in environmental research and service provision, particularly in the areas of water and waste management, we are not taking full advantage of the available opportunities. Out of a national expenditure on the environment of $8.6 billion in

FIGURE 8: Share of ICT industries value added in total business sector value added in OECD countries, circa 1998 (%)

Source: OECD (2000) Measuring the ICT Sector, OECD, Paris

32 Houghton (2001) p.21

1996–97, $4 billion was in imports, mostly in technology. By contrast, we exported only $300 million in technologies and services. While there are lots of small Australian firms with good ideas and products, many are finding it hard to expand due to inadequate access to venture capital, commercialisation expertise and government regulation. A recent study listing the world's 50 largest environmental management companies does not include one Australian company.[33]

Generally, Australian companies are regarded as dismal performers in their adoption of sustainable environmental practices.

There is currently no government plan to facilitate these new industries. Although the Department of Industry, Science and Resources (DISR) has made tentative first steps, more urgency is needed.

Investing in Biotechnology

In its December 2000 report entitled *Global Trends 2015*, the United States Central Intelligence Agency stated:

> Fifteen years ago, few predicted the profound impact of the revolution in information technology. Looking ahead another fifteen years, the world will encounter more quantum leaps in IT and in other areas of science and technology. The continuing diffusion of IT and new applications of biotechnology will be at the crest of the wave.[34]

The report continues that by 2015, 'the biotechnology revolution will be in full swing with major achievements in combating disease, increasing food production, reducing pollution and enhancing the quality of life'. The principal fields of this biotechnology revolution will include:

- genomic profiling (decoding the genetic basis of pathology, enabling medical researchers to move beyond the description of diseases to more effective mechanisms for diagnosis and treatment);

- proteomics (or functional genomics), which identifies the mechanism by which proteins control cell functioning in all forms of life;

- biomedical engineering (spurring the development of sensor and neural prosthetics such as retinal implants, cochlear implants;

- therapeutic and drug developments (curing enduring diseases and countering trends in antibiotic resistance);

- bioinformatics (the rapid processing, storage and manipulation of genomic and proteomic data in support of the above applications).

Already there are significant commercial applications of the biotechnology revolution. Forty-five per cent of all new pharmaceuticals in the year 2000 have been developed from genomics/molecular biology. Two of these products alone— human insulin and erythropoetin—have an annual market value greater than the entire Australian grains crop. Furthermore, the cloning of soil DNA has just identified the first new antibiotics in a generation. These innovations are relevant to the diagnosis and treatment of many longstanding diseases (genetic, cardiovascular, neurological, viral and autoimmune diseases; cancer; HIV; multi-drug resistant TB). These types of applications are potentially of enormous social and economic value to humanity.

The Economic Significance of Biotechnology

The global market for biotechnology has also been projected to grow at 12–20 per cent per annum. World trade in biotechnology is considerably outstripping normal growth in general world trade. For example:

- The OECD estimated in a 1998 report that the world market for products and services generated through the modern health biotechnology sector alone (some 69 per cent of the whole) will reach $US100–305 billion by the year 2000–2005.

- *International Business Asia* in March 2001 estimated the current value of the world biotechnology industry at $US200 billion.

- Ernst and Young, in a 2000 report, estimate the current value of the United States' private biotechnology sector alone at $47 billion—creating almost half a million direct and indirect jobs.

- *Forbes Magazine* estimates that by 2030, biotechnology will occupy 10 per cent of the US economy.

Those who generate and apply this knowledge will transform all of the biologically-based industries that represent half of the world economy and a central part of the Australian economy. These include medicine, pharmaceuticals, agriculture, natural products, waste treatment, and environmental management.

In the biotechnology revolution, it is the ownership of intellectual property that will dictate the winners and losers. While firms can always patent and copyright a better computer or program, there are only a finite number of genes, proteins, cell functions and processes to patent. Australia is falling well behind in the number of biotechnology patents it is generating relative to the United States and other competitor states. The potential economic consequences are staggering.

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33 *Investing in Sustainability: a discussion paper to assist the development of an environmental industry action agenda*, DISR, December 2000, pp.9 & 28–9
    http://www.isr.gov.au/industry/environ/EIAA_Discussion_6dec00.pdf

34 *Global Trends 2015: A Dialogue About the Future with Nongovernment Experts*, United States National Foreign Intelligence Council.
    http://www.cia.gov/nic/pubs/2015_files/2015.htm

Performance of Competitor Countries

Competitor states, including most notably the United States, have recognised that public investment in the R&D base is the critical precondition for the development of biotechnology industries and other high-tech industries. This is an investment in creating new economies made by government on behalf of citizens. The budget of the United States National Institute of Health (equivalent to the NHMRC) is US$25 billion. This contrasts with the NHMRC's budget of approximately $US125 million—i.e. one two-hundredth that of the United States, while our population is one sixteenth.

The Japanese government has committed US$18 billion over the next 5 years with the objective of developing over 500 new biotechnology companies with a projected annual turnover greater than Australia's current GDP. At present, the number of biotechnology companies in Japan (140) is not much greater than the number operating in Australia (120). For the future, however, there is a radical difference in the level of commitment between the two countries' governments.

Advancing economies in our region, such as Singapore, Taiwan and Korea, have made commitments in the order of $US1 billion per annum strategically targeted at developing their life science R&D and accelerating the growth of biotechnology industries. Their science base is weak compared to Australia's, but they have a focus and a commitment that is currently lacking in Australia.

Australian Performance

Private R&D spending in Australia is much lower in the biotechnology industries sector than in most other competitor states, as Table 9 demonstrates.

Public investment in biotechnology R&D is also modest by international standards. According to a 1999 Ernst and Young report,[35] this figure totalled only $257 million or 8 per cent of the total $3,157 million expended R&D. Table 10 illustrates the distribution of this funding across the sector.

The Australian biotechnology industry is demonstrably in the early stages of its development. The number of firms is small. R&D effort, both public and private, is modest, just as the current profitability of biotechnology firms is modest. It is estimated that Australian biotechnology firms currently trade at or near break-even.

Despite these deficiencies, Australia, with strategic leadership from the national government, has the capacity to become a recognised world leader in the life science industries.

■ Australia is one of the world's twelve most bio-diverse countries and the only mega-diverse country in the world that has a developed economy, advanced infrastructure and skilled economy.

■ Australia has a rich scientific base with a strong, but now faltering, academic tradition in the biological sciences—stronger in fact than most other countries in the region. The challenge is to staunch the brain drain, retain the 10,000 life science researchers we

TABLE 9: **Private R&D spending in Australia, Canada, the U.S. and Europe 1998 and 1999**

	Canada (1998)	Australia (1999)	USA (1999)	Europe (1999)
Number of core biotechnology companies	282	120	1283	1178
Number of listed public companies		20	327	68
Companies per million population	9.2	8.3	4.7	3.1
Relative to USA (Companies/capita)	1.9	1.3	1	0.7
Companies per GDP $US 10 b	5	3.3	1.7	1.5
Relative to USA (Companies GDP)	2.9	1.9	1	0.9
Revenue (US $billion)	0.85	0.66	18.6	4.4
Average revenue (US$ million)	3	5.5	14.5	3.7
R&D expenditure (US$ million)	436	159	9810	2754
Average R&D expenditure (US$ million)	1.5	1.3	7.7	2.3

Source: Fayle et al. (2000) Vol. 10, No.3, p37

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35 Ernst & Young *Australian Biotechnology Report 1999*,
    http://www.ey.com/global/gcr.nsf/Australia/Australian_Biotechnology_Report_1999

TABLE 10: Public investment in biotechnology R&D in Australia 1999

	Biotechnology A$m[2]	Total A$m[3]	Share of total funding
CSIRO	40	741	5%
National Health and Medical Research Council	40	216	19%
Australian Research Council	35	436	8%
Cooperative Research Centres	25	140	18%
R&D Start	15	161	9%
Rural R&D Corporations	10	151	7%
Pharmaceutical Industry Investment Program	2	7	29%
Universities	90	1195	8%
Other	0	110	
TOTAL	**257**	**3157**	**8%**

Source: Ernst & Young (1999) p.15.

have, and bring back home many of those researchers we have lost abroad.

■ Australia already has committed State governments, particularly, but not exclusively, in Queensland and Victoria, dedicated to making their States major centres of biotechnology research, development and commercialisation. The challenge for the Commonwealth is to work in effective national partnership with them.

■ Australia has well-established research institutes of national standing specialising in the various sub-fields of the life sciences. The challenge is to enhance these institutes and make them centres of genuine global standing in their field.

■ Australia has a stable legal framework, a well-developed regime for the protection of intellectual property, and mature financial markets. The challenge is to ensure that these and related elements of our overall legal and financial infrastructure are fully supportive of the needs of start-up companies in the life sciences sector.

These challenges demand strategic leadership from the national government if Australia is to maximise its participation in the global biotechnology revolution—and the economic and social dividend to be derived from that revolution. While Australia theoretically has some form of nationally coordinated approach to ICT through the National Office for the Information Economy, no systematic approach yet exists to promote biotechnology.

Our future success as a Knowledge Nation does not rest exclusively on the biotechnology sector. The biotechnology sector, however, will become a major driver of future economic growth. Policy innovation in this sector serves as an exemplar of what can be achieved in other technology sectors—both old and new.

The time for national policy leadership is now.

Conclusions

The application of knowledge to existing and emerging industries has enormous potential to increase Australia's wealth producing capacity and help us improve seemingly intractable environmental, health and social problems. But Australia will only maximise the benefits if it acts decisively now. As this study has shown, Australia is not maximising the potential of value-added manufacturing, ITC, environmental management and biotechnology industries, among others. This is partly because for too long, we have settled for being average performers in investing in the factors that underpin successful knowledge nations, particularly education, training, research and commercialisation. And we have failed to build on our world-leading status in areas like medical research. We lack a coherent national strategy to make us a Knowledge Nation.

In each of these areas, Australia must aim to be among the world leaders, not among the middle of the OECD rankings. We need a national strategy to boost the value-added performance of existing industries and the growth of emerging industries. The following section sets out such a strategy.

WHAT IS TO BE DONE?

The preceding sections have detailed how Australia is falling behind the world's leading wealth creators because it is not yet a high performing Knowledge Nation. They have shown that in the face of a changing world economy where knowledge is paramount, Australia is facing a national crisis.

This section argues that the only way forward for Australia is to become a courageous and effective Knowledge Nation in which every one participates and shares the benefits.

What is an effective Knowledge Nation?

At its heart, the Knowledge Nation is about a national mind shift to a culture in which the national priority is to invest in the minds of all its people so they can deliver the new industries, transform existing industries, and take us down yet unimagined paths of discovery to provide a better life for current and future generations.

The Knowledge Nation is not just for scientists and people working in 'emerging' industries. It will improve opportunities and security for all Australians, whatever their age or level of education, by strengthening traditional industries, creating new jobs, and helping people re-train and re-skill. The Knowledge Nation will be a fairer nation.

What will the Knowledge Nation look like?

1. A Government that creates and promotes effective linkages between research organisations—such as CSIRO, the universities, Cooperative Research Centres and Federal and State Government agencies—to ensure an adequate national database, and inventory of skills, resources and the environment (cadastre). The purpose is to enable effective coordination of national and regional efforts to tackle major problems that threaten the nation's viability, especially in regional and remote areas. Examples of such problems include desertification, soil salinity and acidification, pollution of rivers and erosion.

2. A government that works imaginatively and creatively as a catalyst, encourager, information provider, infrastructure supplier, major customer, and example of world's best practice.

3. A national strategy of ensuring investment in those key areas where it can establish a leading global position.

4. A twenty-first century education system that:

   ■ provides all of its citizens with the opportunity to improve their skills and gain secure and well-paid jobs through properly funded lifelong learning and vocational education programs, including programs at the industry and enterprise level;

   ■ makes every school—State and non-government—a centre of excellence and provides all children with a quality education;

   ■ has universities that attract the world's leading researchers and teachers; and

   ■ encourages fundamental research and the study of the humanities as well as applied knowledge.

5. An economic system based increasingly on innovation and the creation and commercialisation of ideas, and that reverses the serious imbalance in trade in high value added goods and services. This means:

   ■ stronger manufacturing, extraction and service industries transformed by the application of new technologies and the re-skilling of their workforce;

   ■ the development of industries in emerging fields such as biotechnology, nanotechnology, information and communications technology, and environmental management; and

   ■ taking advantage of rapidly expanding export opportunities in service industries, particularly in education, health and environmental management.

6. Core economic and social objectives of leading-edge telecommunications, transport and research infrastructure in our cities and regions, and regional development.

7. Policies that regard saving the environment as an opportunity, and promote sustainability. The application of knowledge to simultaneously promote energy efficiency and higher living standards and create more jobs.

8. A transformed national culture that emphasises knowledge, excellence and innovation, and aims for this to be reflected in its international reputation. Like Ireland, Finland and Israel, our international 'image' must be transformed by creating an inventory of internationally recognised goods and services.

9. The use of knowledge resources to promote the public good, encourage access and equity, provide resources for Aboriginal and Torres Strait Islander peoples, and overcome social, class, regional, ethnic and gender barriers.

10. The creation of a more challenging and creative environment to help reverse the 'brain drain' and assist us in importing the skills we need.

11. The strengthening of great national institutions such as the ABC, CSIRO, galleries, museums, libraries, the Australia Council, the Australian Heritage Commission, Telstra, Australia Post and the Bureau of Meteorology.

The Knowledge Nation will be a fairer nation

The Knowledge Nation is going to be the new source of power relations in the future. It is fundamentally blind to gender, race and other forms of difference.

Far from being elitist, the Knowledge Nation is a force for inclusion, breaking down distance and differences,

ensuring the benefits are enjoyed by women, Indigenous Australians, people from non-English speaking backgrounds, people with disabilities, in short, by all of those who too often have been excluded by the inequitable distribution of power and access in the past.

Nobody should be excluded from the Knowledge Nation, and it is a specific duty of government to ensure that nobody is left out and that nobody is left behind.

Government leadership and commitment

Becoming an effective Knowledge Nation requires aggressive and sustained leadership from the Commonwealth Government in

- creating a long-term vision;
- looking ahead for decades;
- promoting linkages;
- acting as a catalyst, encourager, information and resource provider, and major consumer;
- setting benchmarks for best practice; and
- promoting equity.

The Commonwealth Government, and particularly the Prime Minister, must be the driver of change. It must develop a national strategy and a determination to implement it through all relevant departments and agencies. It must change the national culture to one with an ingrained understanding of the importance of knowledge creation and its commercialisation to the nation's future, and sell this new reality abroad to help transform the rest of the world's understanding of us.

The first step in this program should be a Knowledge Nation Summit. The primary purpose of this summit is to create connections between and within governments and the business, research and education sectors to hasten the creation of the Knowledge Nation.

An international campaign to highlight Australia's culture of excellence must also be undertaken.

The Prime Minister must take ownership of the delivery of the Knowledge Nation and produce an annual report to the nation outlining progress.

RECOMMENDATION 1

The Prime Minister must take the lead in advocating Australia as a Knowledge Nation domestically and abroad, acting as a catalyst to change the culture to that of a Knowledge Nation. The Prime Minister should:

- call a Knowledge Nation Summit to begin the task of breaking down isolation and creating linkages between key players;
- outline a specific national strategy with specific priority industries and a supporting policy framework in

education, training and research to propel those industries into global leadership;

- conduct an international campaign to change the world's image of Australia to that of a Knowledge Nation; and
- report annually to the Parliament on progress in creating a Knowledge Nation.

Create an inventory of existing knowledge resources (cadastre) as the starting point for making connections and utilizing Australia's full potential

While in some ways Australia is already on a path to becoming a Knowledge Nation, we are a disconnected and under-performing one. We already have many of the ingredients of a Knowledge Nation. To harness our impressive—but disparate—Knowledge Nation resources, and extract the full benefit of our national abilities, we must have a clear picture of our resources and optimise their use.

RECOMMENDATION 2

The Commonwealth should coordinate with the States and major research organisations the development of a comprehensive and broadly available inventory (or cadastre) of Australia's resources and knowledge capacity, as a basis for action and policy formulation. The information gathered must be accessible to all Australians.

The Glass Earth—Transforming our "traditional" industries by collecting new forms of data

We often think the Knowledge Nation means investment in new industries, and totally new sectors of the economy.

And yet many of our most innovative ideas and inventions are coming out of what are often seen as 'old economy' industries like the mining and exploration sector.

For instance the CSIRO is working with the private sector on a ten-year project called *The Glass Earth* that aims to map completely the top one kilometre of the entire continent of Australia. This project uses sophisticated computer modelling to 'see through' the earth's crust

The aim is nothing less than trying to find the next Mt Isa or Broken Hill, by building up a total geological picture of the country in 'virtual reality'. A large part of this project involves a collaboration

of Australian companies at the cutting edge of Information Technology.

The researchers and scientists are trying to answer questions about how we can map ancient fluid movements over vast distances, and where a major ore system is likely to occur in this pattern.

The resources sector has always been a technology-driven industry, its companies are leaders in IT and detection technologies. Exploration techniques, extraction processes and management practices are getting newer all the time. The industry is a key driver of research and development, and scientific endeavour across a wide disciplinary sweep in our schools, universities and research agencies.

The Glass Earth is just the latest project that aims to ensure Australia's prosperity into the future, showcasing some of this country's smartest IT knowledge. It is a project keenly watched by the mining and exploration industry overseas, and it is something that should be nurtured by Government.

It is a good example of the potential benefit of creating a Knowledge Bank of Australia's resources.

Increasing and targeting R&D

Research and development is too important to the Knowledge Nation to allow under performance, or even average performance. We have no less a task than leaping to the leading ranks of innovative nations.

Not only must overall R&D spending be dramatically increased, it must be more closely targeted to key Knowledge Nation industry sectors, based on their prospects for commercialising new products and ideas here in Australia, and exports overseas. Five key emerging industries are identified in this report as worthy of targeted assistance (see Recommendations 5-9). A number of others, such as nanotechnology and supercomputing, could also be examined. In yet others, such as medical research (as distinct from biotechnology, although the two are linked), Australia needs to build on its existing success.

Government should be in the business of determining priority industries; it should not be in the business of trying to pick winning companies. But fear of 'picking winners' should not be allowed to constrain Australia from developing a national investment strategy. Such a strategy would build on areas of strengths in existing globally leading industries (including those in the resources and manufacturing sectors and medical research) and potential strengths in emerging industries (including ICT, environmental management, and biotechnology).

Government would work with them to provide a critical mass of infrastructure and R&D incentives and to develop management expertise and a skilled workforce.

Government has an additional role as a 'knowledge broker' to forge linkages between such areas to create new fields of common endeavour.

The Australian Defence Force and Department of Defence can also play a role in exploiting information technologies to maximise the effectiveness of our defence force. A knowledge edge is the most important capability for any modern military organisation. It is essential for Australia's Defence Organisation to take advantage of technological advances and other trends, particularly in integrating the command, control, communication and intelligence systems that underpin that knowledge edge. To maintain a knowledge edge, it is essential that Australia have a modern and innovative industry base to support our Defence Organisation. The Australian Defence Force's acquisition program can play a crucial role in supporting and growing that industry base and encouraging research and development of leading-edge technologies.

The Knowledge Nation must also encompass a deep commitment to the manufacturing industry. In 1999, our trade deficit in elaborately transformed manufactures (ETMs) was nearly $60 billion.

As the report *A Comparative Performance of Australia as a Knowledge Nation* makes clear, a good performance during the 1980s and early 1990s in ETM exports has been allowed to slip since 1996. Taken together, exports of ETMs in the areas of pharmaceuticals, computing equipment, telecommunications, road and other transport vehicles, and clothing, grew by 21.3 per cent per annum between 1985–86 and 1995–96. Over the same period, imports of these ETMs grew at less than half the annual rate (10.2%). Since 1995–96, however, annual export growth for these ETMs has slowed from 21.3 per cent to 9.3 per cent, and been overtaken by import growth of 13 per cent per annum. Before 1996, ETM exports grew at double the rate of ETM imports. Since 1996, ETM imports have grown faster than exports.[35]

The linkages between Australia's manufacturers and the nation's research infrastructure are underdeveloped, resulting in a much slower rate of new product development, new company formation and technology commercialisation than in other OECD countries. The creation of an Institute of Manufacturing will provide a focus for strengthening these linkages and making manufacturing a key component of the Knowledge Nation. Australia's Investment Promotion Program and other measures must focus on securing new investment to expand the nation's productive capacity in ETMs.

35 Considine *et al.* op.cit., pp.39–42

In addition, many economists and business-strategy consultants correctly argue that manufacturing will actually become more important in the first several decades of the twenty-first century because of the emergence of what is referred to as service-enhanced manufacturing. As MIT Professor Richard Lester points out:

> The high value added goods of the twenty-first century will be services enhanced products. Such products bring together manufacturing and services in ways that defy our conventional statistical categories. They bundle together in desirable combinations the capabilities of advanced manufacturing systems, and new possibilities in design, customisation, rapid delivery, quality and product novelty—all enabled by information technologies. The services that make these new generations of products possible depend heavily on information and its rapid diffusion ...

> The importance of taking this broader view is all the greater in light of the global trend towards what we call here service-enhanced manufacturing—the growing significance of intangible products attributes in manufacturing competition. In a very wide range of markets, factors such as convenience of use, speed, delivery, brand identity, fashion, quality, reliability and a variety of services designed to enhance the experience of buying and using the product are featuring more and more prominently. The key to manufacturing competition in the coming decades will be the ability to bundle together a tangible good with an array of intangible services to produce the most desirable product.[36]

RECOMMENDATION 3

Australia should increase its public and private sector R&D performance by:

■ Doubling Australia's overall R&D as a percentage of GDP by 2010, bringing Australia to the top of the OECD tables.

■ Targeting R&D incentives and action agendas to key Knowledge Nation industries, including the industries with currently globally competitive positions such as wool, tourism, wine, iron ore, coal and beef; established potential growth industries such as education, health and medical research; and emerging industries such as ITC, environmental management and biotechnology. Additional areas for national effort should be decided through a national foresight process that brings together experts from across society to identify opportunities for economic improvement.

■ Using the nation's investment promotion program and other measures to expand our productive capacities in

ETMs and foster the linkages that will accelerate the rate Australia develops new products, forms new companies and commercialises technology.

■ Drawing on existing university and non-university research bodies to build three national institutions of global standing in the three key emerging sectors of ITC, environmental management and biotechnology.

■ Creating an Institute for Manufacturing as a centre of excellence for industry research and development.

■ Introducing additional R&D concessions for businesses in selected sectors that conduct research in conjunction with public sector research bodies and universities.

■ Promoting the core enabling disciplines within the fields of science, engineering, the social sciences and the humanities, in school and higher education.

■ Increasing support for the CRC program while ensuring rigorous selection processes for the establishment of new CRCs. This should include the creation of additional CRCs in ITC, environmental management and biotechnology.

■ Significantly increasing funding to public sector research bodies, including the CSIRO, AIMS, the NHMRC, the ARC, the Bureau of Meteorology, ANSTO, DSTO and others.

■ Using the Australian Defence Force's acquisition program to support Australia's high-technology industry base and encourage research and development of leading-edge technologies.

Commercialising Australian R&D

Other recent reports have made recommendations on how to improve the commercialisation of research in Australia. Recommendations have included:

■ expanding the CRC program to improve the commercialisation of university research;

■ encouraging more clustering through additional programs that provide a strategic industry sector focus, similar to the Building on IT Strengths (BITS) model;

■ establishing innovation centres, a technology incubator program and appropriate commercialisation advisory services to build management expertise;

■ creating pre-seed capital funds for public sector research institutions; and

■ providing more opportunities for public sector researchers to share the benefits of commercial spin-offs from their intellectual product.[37]

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36 S Berger and R Lester (1997) *Made by Hong Kong*, Oxford University Press pp xiii & 30

37 *The Chance to Change*, pp.44–53; *Innovation Unlocking the Future*, pp.20–31

The Taskforce endorses these recommendations, but would like to see an even greater focus on issues that will make Australian companies in emerging industries more competitive and that will attract overseas companies to Australia. Unless Australia addresses this issue, we will fail to maximise the benefits from public and private investment in research through CRCs, incubators, institutes, universities and other bodies.

Australia needs to acknowledge that we are competing with other nations that have tax and other incentives for commercialising research in emerging industries.

One challenge that has been neglected is providing for an employee share options program that creates incentives for entrepreneurs.

Options are used to create an environment of shared ownership. They create an incentive for employees in these high-risk enterprises to work at aligning objectives and creating the maximum possible wealth for all shareholders in the business.

But it is recognised that the success rates of start-up companies is very low. Even in those that are successful, the original shareholders rarely realise any return on their equity for several years.

In these circumstances, employees are encouraged to consider options as a 'long shot' bet in a game in which they have limited control over the odds. What control they have is completely related to their abilities and willingness to commit themselves to the business endeavour in the medium to long term.

The present employee share options framework urgently needs reform, and although the government has acknowledged this, it is yet to develop a new program. It is important to note that any new options program must be immune to the potential of tax avoidance schemes. It would immensely damaging to a nascent entrepreneurial culture should a program be introduced, only to have it discredited.

It is urgent that an Employee Share Option Program be made available to fast growing start-up companies.

Two approaches are needed: benchmarking ourselves against other competitor nations, and examining all the impediments to commercialising Australian research, including taxation.

Just as important, though, is changing the culture of Australia. Just as we are seeking to generate greater public acceptance of the need for research and development, so we need to generate greater acceptance of the need for more entrepreneurial activity. Those who take risks and ultimately succeed in opening global markets for Australian research should be as prominent and praiseworthy as the researchers themselves.

RECOMMENDATION 4

The Commonwealth Government should undertake a thorough review of the impediments to the commercialisation of Australian research, in targeted emerging industries. This strategy should:

■ benchmark Australia against other successful Knowledge Nations, such as Ireland, Israel, Singapore and the United States; and

■ recommend tax and other incentives that will encourage greater commercialisation (see also Recommendations 3, 5, 6 and 7).

The Taskforce believes, however, that the commercialisation of Australian research will only be improved significantly if we send strong signals to business by getting the fundamentals right. This means attracting large players in the worldwide pharmaceuticals industry to commercialise home-grown biotechnology research (see Recommendation 5). It means securing investment in a wide range of ETM industries to upgrade their organisational capabilities and management systems, thus improving their capacity to commercialise Australia's research outputs. This must include the capacity for firms to upgrade their organisational capabilities and management systems. The Karpin Report of 1995 flagged fundamental changes required for management education.[38] It means getting the telecommunications and digitisation policies right (see Recommendation 5). And it means getting environmental regulations right. But the final and possibly most important factor is to convince business that there is the leadership and the strategy to make Australia a Knowledge Nation (see Recommendation 1).

Key Industries

The engine of wealth creation for the past two centuries was built around goods-producing industries, particularly manufacturing. Today, a new engine of wealth creation is emerging, based on information processing, the Internet and supporting infrastructure. But it is a false dichotomy to argue that there is a 'new economy' and an 'old economy'. On the contrary, it is the application of advances in science, engineering and information technology, and the utilisation of the online economy by companies in mining, tourism, agriculture, manufacturing, warehousing, transport and a wide range of service industries, that is and will continue to render obsolete any hard and fast dividing line between old and new industries or companies. These terms are used occasionally simply to facilitate comparisons and communication and highlight differences.

Similarly, the key industries on which the Taskforce has focused for future growth and development do not exist in

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38 D Karpin (1995) *Enterprising Nation: renewing Australia's managers to meet the challenges of the Asia-Pacific century*, Canberra

isolation. A nation cannot realise the full potential of its ITC, environmental management and biotechnology industries without a strong service-enhanced manufacturing industry, world-class science and engineering facilities, and a host of other industries and occupations through which linkages are established. The reader should bear this is mind when considering the Taskforce's findings on the emerging growth opportunities in the following key industries. They are not the only growth opportunities of the future. But they are critical to the success of Australia as a Knowledge Nation.

Key industries 1: Information and Communications Technology

Information and communication technologies (ICTs) represent an industry sector that is yet to reach its full potential in Australia as a result of policies that have stifled innovation and growth. As ICT is an enabler of innovation in the public and private sector, the combined strategy of identifying ICT as a key industry and pursuing affordable, high bandwidth access to communications infrastructure will complement other strategies to build Australia's capacity to become a Knowledge Nation.

Due to policy failures, Australia is not a pace setter and leader in ICT; we are a user and follower. We must become both a technology user and a technology creator. Australia must build on its strengths as an early adopter of ICT to create a larger software and hardware industry.

Government must play a leading role by moving government services online, in particular, education, health and innovative forms of government administration and service delivery. Extending government services online may create savings that could be used to expand broadband digital access to all Australians, thus helping to avoid the widening of the digital divide, an expression to describe the inequities between those who have Internet access and those who do not.

Government must also use its purchasing power to ensure that government contracts are available to small to medium enterprises (SMEs) in the ICT sector. With governments responsible for over 40 per cent of ICT purchasing in Australia, there is potential to provide strategic growth opportunities for existing SMEs, particularly those expanding their export opportunities.

There are relatively under-developed opportunities for growth in niche sectors of ICT.

One such sector is photonics, the use of particles of light to communicate, store and process information, including optical fibre networks. Photonics is a strategic growth industry in its own right and an enabling technology providing broadband solutions to underpin the transformation of existing industries. (See breakout box on Photonics).

ICT is embedded in almost every industry and activity of a Knowledge Nation. Creating high-level capacity in ICT infrastructure and skills is an essential prerequisite to modernising Australia's education, health and other services, strengthening existing manufacturing industries and creating new industries.

For government administrations, researchers and business, the availability of high bandwidth is a prerequisite to a culture of innovation.

Broadband communications networks will form the backbone of new industrial organisations. Business-to-business trading environments will become, if they are not already, the platform on which companies do business with each other, and the Internet will be the internal communications medium through which businesses organise themselves. As more and more businesses and people are linked to the electronic nervous system of global business, the thirst for bandwidth will explode.

However, capacity and influence to expand broadband access also requires improving the current telecommunications regulatory arrangements.

While Australia does have high Internet use compared to many other nations, we must ensure that we improve as other nations implement ambitious programs to boost their own levels of digital technology use.

The Commonwealth should retain its majority public ownership of Telstra—Australia's leading ICT company—to help ensure that affordable digital broadband services are available to all Australians.

A key strategy for achieving universal digital broadband access will be to move from the existing Standard Telephone Service to a Standard Communications Service. The current Standard Telephone Service guaranteed to all Australians requires only the provision of voice telephony services. The Standard Telephone Service mandates a standard data speed (bandwidth) of 2.4 kilobits per second (kbps). This is the minimum necessary for voice telephony of reasonable quality. However, it is totally inadequate to provide even basic dial-up Internet services.

The Howard Government's recent announcement that it will encourage, though not legislate for, Telstra to provide a minimum 19.2 kbps data speed is also insufficient to provide all Australians with reasonable dial-up Internet access. By contrast, for example, it is expected that by 2005, 95 per cent of households in Denmark will have access to at least 256 kbps, and 70 per cent will have access to 2 Megabits per second (Mbps).

The Digital Data Service Obligation (DDSO), introduced in 1999, provides all Australians with access on request to a minimum 64 kbps ISDN or equivalent data service. The DDSO no longer reflects the latest in available broadband technology, nor has the subsidy available under it proven

to be attractive. To date, only 74 Australians have taken up the DDSO on other than fully commercial terms.

The Customer Service Guarantee framework sets maximum timeframes for telecommunications carriers to connect customers to their network, or to repair or service the connection of existing customers. Currently, the Customer Service Guarantee only ensures the timely connection and repair of voice telephony services. It should also be upgraded to take into account data services.

Timing is important. For Australia to develop into a Knowledge Nation, we will need to be at the forefront of some world developments. Digitising Australia's cable networks and ensuring access to broadband as urgent national policy priorities will bring us into the lead, along with a small number of other countries, in having the platform to develop the next generation of services.

RECOMMENDATION 5

The Commonwealth should make it an urgent national priority that all Australian households and businesses have the option of access to digital broadband. This could be done by:

- Using the array of Commonwealth powers, capacity and influence to expand broadband access. This will include improving the current regulatory arrangements and maintaining majority government ownership of Telstra.

- Upgrading the current standard telephone service, which mandates minimum levels of voice telephony service, to a standard communications service that mandates minimum levels of data transmission.

- Improving the competitive and regulatory environment to ensure fair access to the Customer Access Network and to ensure that broadband cable networks are open, digitised and inter-connectable as soon as possible.

- Providing incentives, including investing in broadband networks, for the take up of broadband technology.

- Making Government a leader in the use of high broadband technology, including innovative online government services.

- Ensuring that all Australians, particularly those in regional areas, have the opportunity to access fixed-price, untimed calls nationwide, for both voice telephony and data services.

- Removing the existing restrictive and failed datacasting regime and opening up a new digital spectrum to the exciting, potential new services of the future.

- Building a national strategy around the growth and development of Australia's software and digital content sector, including a comprehensive capability inventory.

- Using improved government procurement policies to encourage the further development of an Australian ICT industry.

- Closing the digital divide by using community and regionally based strategies to improve skill levels and assure affordable Internet access.

Photonics—A Strategic Growth Industry for Australia

Photonics, the use of particles of light to communicate, store and process information, presents a unique combination of three features that mark it out as an industry worthy of special Government attention. Firstly, as a strategic growth industry in its own right. Secondly, as a foundation, national, enabling industry to underpin the development of all other industries, and thirdly for the opportunity it presents, through the conjunction of the first two features, to develop a suite of new answers the growing inequities in society that are related to access and use of information technologies (the digital divide).

1. Because of investment in Photonics in the early 1990s, Australia today has a rare opportunity to be a leading participate in the next generation of giant, global high tech industries.

   Photonics networks are the optic fibre pipes and light-based switches that will be the backbone and nervous system of the Internet, which means it can only continue to grow. Australia has already developed a global reputation for excellence in this field and therefore is strongly positioned to develop core photonics technologies for the global market.

   Even post the "tech wreck", photonics is one of the most exciting industries in the world, attracting $US3.4 billion in venture funding for optical networking in the first nine months of 2000. Total optical networking equipment sales are predicted to increase from $US30billion in 2001 to $US70billion in 2006 (Insight Research Corp).

   Already, Australia has produced a handful of global leading niche Photonics companies and captured the attention of the photonics world with its innovative science. Being a leading participant in the industry in the next decade is an opportunity so important it is worthy of the status of a national mission.

2. Broadband communications networks will form the backbone of new industrial organisation, and will be at the core of all industries.

Business to business trading environments such as the auto industry electronic trading market, will be the platform on which companies do business with each other, and the Internet will be the internal communications medium through which businesses organise themselves. As more and more businesses and people are linked to the electronic nervous system of global business, the thirst for bandwidth will explode.

High bandwidth access will be the enabler for businesses wanting to participate in international trading platforms or to employ the latest management techniques. Australia needs to encourage the rollout of world-best broadband networks in the same way as it had to build world-class roads, rail and ports to allow past generations of industry to compete internationally.

3. The combination of a strong and innovative Australian photonics industry and a business sector savvy to the opportunities presented by broadband communications will enable a national strategy to address regional development and the digital divide.

As the demand for broadband and the domestic capacity to provide it grow, it will create an opportunity for communities to connect into the new networks. Already, Canada and the US have seized opportunities to bring communities into the mainstream of new job, education and social opportunities through projects such as the Canarie network in Canada and community-based schemes in cities such as Palo Alto and Cedar City in the US.

Australia, with its photonics industry, educated and technology-aware population and advanced economy, can lead the world in bridging the Digital Divide.

Key industries 2: Making Australia a world leader in biotechnology

Dr. Peter Andrews of the Institute of Molecular Bioscience at the University of Queensland has argued that Australia is at the cusp of the third great economic revolution of the modern era—the biotechnology revolution.[39]

The world-wide explosion of the transformational impact of the second revolution of the modern era—that of ITC—did not prevent Australia's standard of living slipping to 26th in the world. A century earlier, Australia ranked first in the

world. Australia also slid from being the first to the fourth largest economy in East Asia. And we enjoy the ignominy of now being second last after Argentina among OECD exporters of high technology.

Dr. Andrews' challenge is whether Australia will fall further and further behind in its terms of trade and the international table of nations if it fails to capitalise fully on the next quantum transformation of the world economy: the revolution in biotechnology.

The Taskforce's response to this challenge is that our national government must establish a clear-cut national goal of making Australia a world leader in biotechnological research, development and commercialisation by 2010, building on our existing strengths in medical research. This will require specific action plans.

A national biotechnology meeting should be convened involving the States, the life science research community and biotechnology companies to *determine a coordinated national biotechnology strategy* to develop the industry in Australia. If Australia is to become a world leader in this industry, it must concentrate its efforts on those sub-fields in which it has an existing research base—rather than spreading that effort too thinly.

The NHMRC and ARC grants system should be restructured (or augmented by the establishment of a specific National Biotechnology Research Grant) to allow for large-scale biotechnology projects of national significance. The Taskforce recommends at least two such national projects.

1. An Australian Genome Project to explore the genetic and molecular characteristics of key animals, plants and micro-organisms of relevance to Australia's unique biodiversity and of commercial significance to the global economy.

2. A *National Proteomics Project* aimed at the commercial application of the emerging body of genomic research to diagnostic and therapeutic medicine. In part, it may take the form of providing advanced research platforms for the high-speed processing of protein data under different conditions.

The Taskforce further supports the creation of a radically improved environment for life science researchers to reverse the brain drain and secure the return of the brightest and the best Australian expatriate life scientists from abroad. In part this relates to employment conditions and in part, to the international standing of Australian research institutes compared with their competitors. *To this end, Australia should develop three life science research institutes of undisputed global standing. One of these may be designated a National Life Sciences Centre.*

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39 PR Andrews. *'The Technology Environment for the 21st Century: Biotechnology'*, paper presented at the 1998 Symposium of the Academy of Technological Sciences and Engineering: Technology—Australia's Future: New Technology for Traditional Industry
http://www.atse.org.au/publications/symposia/proc-1998p2.htm

All three should be built on the existing (and largely rusting) institutional base.

A further priority is the creation of a network of biotechnology business incubators. These incubators should involve the co-location of researchers, entrepreneurs and venture capitalists. Where possible, this would occur within the precincts of universities and/or research institutes. Xcelerator, a company in North Ryde that already provides bio-incubation services to biotechnology start-up enterprises, may provide a model.

The creation of a biotechnology industry-wide information Internet portal—or a 'BioInfoHub' would provide an industry-wide free flow of information as well as a range of satellite sites for Bioentrepreneurs, BioResources, BioMentor, BioJobs, BioInvest, BioNews, etc. It should be jointly funded by government and industry.

To oversee biotechnology developments requires the establishment of a *National Biotechnology Advisory Committee* headed by a chairperson of global standing in the industry. This committee should be serviced by an *Office of Biotechnology* within the relevant agency in Canberra. This modestly staffed machinery would drive the implementation of the National Biotechnology Strategy.

Australia urgently needs a *National Life Sciences Education Strategy* for the long-term development of the national skills base necessary for the nation's future biotechnology industry needs. This would address the inadequate supply and quality control of maths and science teachers through the nation's school system, the structure of undergraduate courses, and the incentives necessary to expand the nation's doctoral and post-doctoral programs.

To boost commercialisation of biotechnology research in Australia, we need a *detailed review of the impact of the tax system on biotechnology start-up companies.* This would cover roll-over provisions, CGT treatment and employee share ownership schemes. Building on Ireland's experience with ITC, it might also include a 0 per cent company tax on defined biotechnology start-ups for a period of five years as a means of symbolising government's strategic commitment to the sector.

One task that must not be overlooked is the *development of a National Code of Ethical Practice* for the Australian biotechnology industry. This is a gaping hole at present and serves to exacerbate the concerns of those critical of the contemporary manipulation of the molecular structures of plants and animals. It could draw readily on the code already developed by the Queensland Government. It is crucial to provide a certain framework for researchers, entrepreneurs and the community.

RECOMMENDATION 6

The Commonwealth must build on Australia's strengths in medical research by adopting a goal of making Australia a world leader in biotechnological research, development and commercialisation by 2010. This will require:

- A meeting of the nation's biotechnology experts to determine a coordinated National Biotechnology Strategy for the development of the industry in Australia as a priority.
- Restructuring NHMRC and ARC grants to allow for large-scale biotechnology projects of national significance.
- Funding an Australian Genome Project and a National Proteomics Project to concentrate research effort and build on existing Australian strengths.
- Developing three life science research institutes of undisputed global standing. One of these may be designated a National Life Sciences Centre. All three should be built on the existing (and largely rusting) institutional base.
- Creating a network of biotechnology business incubators.
- Creating a biotechnology industry-wide information Internet portal—or a 'BioInfoHub'.
- Establishing a National Biotechnology Advisory Committee headed by a chairperson of global standing in the industry, serviced by an Office of Biotechnology within the relevant agency in Canberra.
- A detailed review of the impact of the tax system on biotechnology start-up companies and foreign investment.
- Specific adjustments to national immigration policies to encourage global-leading biotechnologists to come to Australia and expatriate Australian leaders to return.
- Developing a National Code of Ethical Practice for the Australian biotechnology industry.

Xcelerator Biotechnology Incubator

Xcelerator (website: www.xcelerator.com.au) is a professional biotechnology incubator business located in the 'Biohub' of North Ryde NSW. Xcelerator provides complete support to start-up companies working in the biotechnology sector and an environment and infrastructure which is highly conducive to allowing start-up businesses to get on with the task of developing their new venture and growing rapidly. Xcelerator has three key aspects to its business.

Biobusiness Incubation

Xcelerator provides clients with a competitive edge through access to its unique combination of experience, insights, knowledge and networks in business and science, all critical factors to the future success of incubator companies. The aim of Xcelerator is to add value to early stage companies though the provision of its incubator services, and

in assisting companies to reach a point where they have become strong independent businesses. Xcelerator seeks in return to derive value from its investment in an incubator company. In return for its original investment Xcelerator takes an equity position, the level of which depends on a number of factors such as: the level of risk, the stage of the technology development and the need for future resource allocation to the company or project.

Bioentrepreneur

Bioentrepreneur.net (website: www.bioentrepreneur.net.) is a business unit of Xcelerator Ltd, which develops and presents continuing education workshops on business development for those working in the life sciences. Xcelerator has developed Bioentrepreneur to service a gap in the market, and as part of its commitment to developing educating and growing the life sciences biobusiness sector in Australia in line with international worlds best practice.

Commercialisation & Advisory Services

Xcelerator assists with all aspects of biotechnology commercialisation, from project evaluation, due diligence, business planning and introductions to potential investors. Xcelerator works with investors who wish to have technical and commercial evaluations performed.

Key industries 3: The environment as an opportunity

Australians are now realising the enormous damage we have inflicted on our continent and the need to create a sustainable future.

The environment is an opportunity as well as a challenge. If we use our Knowledge Nation capacity in a focused way we can fix environmental problems, prevent further damage and create a potentially huge export industry in environmental management technology and intellectual product, particularly in the areas of land care, water and waste management, and sustainable energy. All levels of government and the private sector must be involved. Currently, Australian companies are behind other leading nations in their level of awareness of sustainability principles.

There are enormous benefits for regional and rural Australia in particular. By fully using Australia's intellectual capacity we can fix problems relating to salinity and efficient use of water, improve rural quality of life and provide income-producing technologies.

The Taskforce believes that Australia urgently needs a strategy to concentrate more public and private resources

into creating environmental technology and environmental management export services industries.

The Taskforce also believes that we need to create greater awareness in the community of sustainability principles, particularly 'dematerialisation', and build 'triple bottom line' (financial, social and environmental) principles into government and corporate investment decisions. Creativity will flow if as a result.

RECOMMENDATION 7

That the Commonwealth initiate a massive campaign, in conjunction with the States and all major research organisations, to start a ten-year program to tackle the problems of salinity, land degradation and acidification of soils, polluted rivers and sea coasts, land clearing and deforestation, loss of species diversity, and to implement a strategy to expand Australia's environmental management industry, for which we already have a high-level capacity. Elements in this strategy should include:

■ a goal of obtaining a significant proportion of the global market of environmental management goods and services by the year 2010;

■ development of a specific set of quantitative metrics and milestones for the year 2010 and each year beforehand to monitor success and highlight failures as the program unfolds;

■ a targeted environmental management R&D program, including support to improve the sustainability performance of industries that have traditionally been both environmentally damaging and global leaders, and to generate new export industries from the expertise developed in doing so;

■ the creation of environmental management CRCs, innovation investment funds and venture funds leading to the development of significant indigenous industries in environmental management;

■ an environmental technology and services export program;

■ renewable energy and energy efficiency initiatives;

■ specific adjustments to national immigration policies to encourage environmental scientists and management professionals who are global leaders to migrate to Australia and the return of expatriate Australian leaders; and

■ a campaign to promote understanding of the process of 'dematerialisation' in industry and the community.

Heartlands—towards sustainable land use in the Murray-Darling Basin and the creation of Australian IP

The CSIRO's *Heartlands* project illustrates how by using our knowledge capacity is a coordinated way we can address difficult environmental problems, export valuable intellectual product, create new jobs and make regional Australia a central part of the Knowledge Nation.

Land and water degradation, especially dryland salinity, poses a serious long-term threat to the sustainability of the Murray-Darling Basin. Changed management of agricultural landscapes, including well-targeted revegetation on a broad scale, is the most viable means to reverse the ongoing environmental degradation.

The *Heartlands* initiative will develop efficient strategies for well-targeted land use in the Murray-Darling Basin. It will support implementation of the strategies, and verify their effectiveness. Heartlands is developing and applying the knowledge required to target revegetation works for maximum benefit. It will build on existing knowledge and related research being undertaken by CSIRO and other organizations.

Heartlands is an innovative long-term program combining on-ground-works with research and development. Scientists will work closely with catchment managers and the community to:

- Support catchment management;
- Help to rehabilitate the landscape in a way that is sensitive to the needs of society and the communities affected;
- Assist rural communities to manage land use change;
- Estimate the benefits and costs of changed land management; and,
- Provide confidence that the proposed solutions work.

The *Heartlands* initiative will:

- Contribute to new land use options that combine commercial success with sustainable resource use;
- Provide the ability to locate appropriate land management options—reforestation, environmental plantings, and improved agriculture—in specific locations in a catchment to maximise environmental benefit;
- Building understanding of the extent and nature of land use change necessary to meet salinity and water quality targets, maintain water security and enhance biodiversity conservation;
- Verify the effectiveness of landscape design strategies in meeting these environmental imperatives whilst providing long-term economic returns;
- Provide practical support for community-based catchment planning, monitoring, and the implementation of adaptive catchment management processes;

- Delivery support for policy initiatives to help in implementing necessary land use change; and,
- Provide practical examples of techniques and guidelines for broad-scale land use change that can be adapted and replicated elsewhere in Australia and exported overseas.

Key Industries 4: An education export industry

One of the major potential uses of information technology is online education, which provides one means for offering accessible and affordable opportunities to many Australians who are currently locked out of higher education by geography, disability, lack of ability to attend the campus, and cost.

Unless Australia establishes a leading online education industry with the emphasis on quality, millions of dollars and highly-skilled jobs for Australians will be lost overseas.

Due to our expertise in distance learning, Australia is currently strong in online education. Already, a number of Australian universities offer extensive courses online and have incorporated online elements into their day-to-day activities.

Australia must take full advantage of the head start we have established and become a world leader in online education at both university and school levels. But online university education must not be an alternative to providing proper levels of funding for existing universities. It should be one of a variety of learning environments for students to choose. Online education is only worthwhile if there is a commitment to providing high-quality courses and teaching, and if it replicates many of the strengths of traditional universities, such as one-on-one teaching and broad subject offerings across all disciplines. Governments must ensure that the benefits of online education are available to all Australians, not just those who can participate in a fee-paying market.

RECOMMENDATION 8

Australia must aim to become a world leader in online education at all levels within the next few years, winning at least 10 per cent global market share of revenue. Achieving this will require:

- ensuring that courses are as good as, if not better than, those offered in traditional formats;
- upfront investment to create quality online courses and retrain teachers and academics in their effective use;
- developing a leading online education content industry and encouraging the industry to adopt leading-edge methods of online marketing and distribution to attract students;

- research into the most effective online teaching, user interface requirements and online customer service infrastructure;

- improving necessary infrastructure, including access to affordable bandwidth (particularly in regional Australia), adequate computer backbones and digitised libraries;

- financial incentives for students to study online, the availability of widespread public information on courses, and simple 'one stop shop' enrolment processes; and

- ensuring that individual academics, universities, TAFE colleges and private vocational education providers benefit from the creation of intellectual property.

The Connected Learning Community— John Paul College, Brisbane

John Paul College (website: www.jpc.qld.edu.au), a co-educational P-12 school in Brisbane, recognised in the early 90s the changing dynamics of education and the immediate benefits of using Information Technologies as a vehicle to enhance teaching and learning outcomes and deliver its student-centred philosophy of education. This has now developed into one of the world's largest school computer Notebook programs and an internationally recognised exemplar of integrated teaching and learning delivered through a technology program which sees over 1800 staff and students using their notebooks and an online curriculum on a lesson by lesson basis.

The College has recognised that, for its students, learning is no longer confined to the hours and walls of a classroom, but rather, takes on a global and multicultural perspective as students become active participants in developing our knowledge economy through collaboration with teachers, parents and the wider community. This new reality is reflected in the College's vision, near to completion, of a Connected Learning Community.

New technologies have been implemented to facilitate anywhere, anytime learning. These include wireless connectivity throughout campus to both the Internet and College information learning

portals, the introduction of a learning management system, Encarta Class Server (ECS) to facilitate the development of interactive digital content and deliver online curriculum, student personal and public web pages and email accounts, and web cameras in classrooms. A Virtual Private network from home provides access to all school community members. Underpinning the program is a massive commitment to professional and curriculum involvement which is critical to the ongoing success of the program.

This blending of infrastructure, access, knowledge and empowerment of students, teachers, parents and the community are features that distinguish John Paul College as an example of a 21st Century learning community. The next stage of the College vision will be realised when the College launches its **myjpc.com** community gateway on July 26 2001 by Paul Lucas, the Queensland Minister for Innovation and Information Economy.

myjpc.com is the central knowledge gateway of the JPC connected learning community. It will link students, teachers, parents and the community to:

- Administrative information such as attendance, College calendars, daily notices;

- Results from co-curricular activities such as golf, hockey, netball and rugby;

- Study hints for students and support mechanisms for parents;

- Hot sites—educational, sporting, cultural, financial;

- Video conferencing and chat groups for special interest groups, parents, students and alumni;

- Community professional training sessions in technology that provide certification such as the International Drivers' Licence;

- An email account and web site for each family in addition to student and staff accounts;

- Community Virtual Shopping mall;

- Community Radio station; and,

- Web streaming of major College events.

Online Universities and TAFE—making lifelong learning a reality and creating a new export industry

Online education is regarded as one of the crucial areas of content development for the Internet. Unless Australia established a leading online education industry, overseas institutions will fill the void and we will miss the opportunity to create thousands of skilled jobs for Australians.

- Many of the world's leading universities, including Stanford, Princeton, Yale and Oxford, have recently combined to offer online courses.

- The Massachusetts Institute of Technology (MIT) is offering its curriculum to the world free of charge as an incentive to attract international students to its courses.

- The Blair Government is establishing a UK e-University (*http://www.hefce.ac.uk/news/default.asp?Page= HEFCE/2000/euniv2*) and extending the principle to vocational education through its University for Industry (*http://national.learning.net.uk/ufi1.htm*).

- The United States Army—a large-scale educator—has established its own online university (*www.earmyu.com*) to provide tertiary education to its members.

Online learning is already an established part of traditional campus-based teaching in all tertiary institutions, particularly the world's leading universities, such as Harvard, with lectures webcast, tutorial discussions held online, and written work submitted electronically. In fact, by using ICT, universities and VET providers can potentially increase the level of interaction between students, tutors and lecturers. The conversion of library holdings into digital format—an essential feature of online universities—holds the promise of easing the problems associated with increasingly crowded and understocked libraries. In short, online learning is about helping existing universities and VET providers do even better the things they already do.

Australian tertiary institutions are in the vanguard of this change. The following table lists just some of the online initiatives currently under way, particularly at joint university and TAFE institutions.

University of Southern Queensland

Has a subsidiary—USQOnline (*www.usqonline.com.au*)—that provides courses in Nursing, Commerce (including MBA) and ICT degrees.

Central Queensland University

Is currently developing 3 online degrees.

Edith Cowan University

Has a virtual campus, that provides tutorials, chat rooms, reading lists, etc.

The University of Ballarat

Has a subsidiary—UBOnline (*www.ballarat.edu.au/ubonline/*)—that offers a wide range of online courses.

Charles Sturt University

Provides tutorials, chat rooms and teleconferencing for students.

Newcastle University

Has a subsidiary *www.gradschool.com.au* that provides postgraduate courses.

Murdoch University

Has a subsidiary—Murdoch Online (*www.murdoch.edu.au/online/*)—that offers 23 postgraduate only certificates, diplomas and degrees across 3 faculties—social sciences, humanities and education, science and engineering, and business, information technology and the law.

The University of New England

Provides 300 online courses through a subsidiary UNE Online (*http://online.une.edu.au/*).

La Trobe University

La Trobe has a Centre for Online and Multimedia Education Technologies (*http://www.latrobe.edu.au/www/mpu/*) that works with teaching staff to develop online courses and improve the use of ICT in on-campus teaching.

The TAFE Virtual Campus

TAFE VC (*http://www.kangan.edu.au/vc/tvc_fram.htm*) is an umbrella shopfront for online courses at Victorian TAFE campuses.

U3A

University of the Third Age has an online presence (*http://u3aonline.edna.edu.au/*). These are not-for-degree, leisure courses.

Other institutions are combining with the intention of bundling courses for delivery through large international Internet/datacasting companies, spreading the risk across a number of universities.

The opportunity exists for Australia to become a world leader in online university education.

Key industries 5: A medical export industry

Australia produces world-class medical services and we have developed innovative ways to deliver these services across vast distances. Our health system is particularly good in training our health workforce, including workers in the speciality areas. There is a high demand for our medical expertise in the Asia-Pacific region and with appropriate support, these services can be exported, providing important revenue that will enable our own services to be further enhanced. Done properly, the development of a major medical export industry can be a win-win for Australia, improving the health of Australians while creating thousands of well-paid jobs. Such an export industry must, though, build on the further improvement of Australia's system of universal health provision.

A large proportion of the health sector, such as hospitals, is under the control of government(s), and certainly much of the rest of the sector is influenced heavily by government policies. The Commonwealth and State Governments, therefore should take the lead in transforming the sector and encouraging the development of international markets for those areas in which we are competitive. Many countries around Australia do not have the high-end services available here, but their populations are prepared to pay for them. The high costs of health care in the United States and some European countries, possible alternative suppliers, makes Australia very competitive.

A key area of opportunity is telemedicine. Developments in telemedicine pioneered in Australia provide significant export opportunities. Telemedicine can now be used to transmit x-ray images and scan images, view pathology slides from remote sites, and conduct face-to-face consultations in real time. Australian hospitals are already using telemedicine links to provide Australian cancer patients with access to multidisciplinary tertiary cancer specialists thousands of kilometres away without having to travel vast distances. The technology also enables specialists to provide online guidance and support to doctors and health workers in small communities, thus improving the quality of care and preventing unnecessary travelling and referrals.

Super-specialty areas of medicine require significant throughput to keep them at the leading edge of developments and experience. In some speciality areas, Australia is not a sufficiently big catchment area. Therefore, to be successful these areas have to look to establishing centres of regional excellence. Singapore, a recent mover into super-specialties, has recognised this and is funding its centre of excellence to significant levels. This is a major growth area in high value added services. If Australia does not act decisively, there is the risk that some super-speciality areas will exit the country to locations that support their objectives.

A Year-12 school retention target

There is a mistaken view that the Knowledge Nation is only about universities and scientists. Knowledge Nation is about raising the standard of education at every level. In the twenty-first century, everyone will require access to post-compulsory education of some kind.

A highly educated and trained population is the foundation of an effective Knowledge Nation. A vital step, therefore, must be to create a better education system, with opportunities for all. This will require a massive reinvestment programme in schools, universities and vocational education.

Australia's educational performance must be raised dramatically, starting at the level of primary and secondary schools. Year 12 retention rates are stagnating in the low-70 percentage points range, down from almost 90 per cent in some States at the start of the 1990s. Retention rates are significantly lower in public schools than private schools. While Australian students perform above average in international measurements of maths and science, we must aim to be at the top of these tables. There is concern that the situation is actually worse than these tables suggest; in the knowledge world, average will not be good enough.

A starting point for improving our education and training system must be a steep rise in Year 12 equivalent retention rates and ensuring that the remaining people gain a post-compulsory education qualification that will improve their prospects of gaining a well-paying job.

RECOMMENDATION 10

Australia must ensure that by the year 2010, a minimum of nine out of ten young people leave their teens with a Year 12 equivalent qualification, and that all young Australians achieve a formal education or training qualification at the post-compulsory level.

Revolutionary Improvements to our Schools

Achieving these targets will require thorough overhaul and modernisation of our education system, with significantly increased funding. We do not need just little changes; we need revolutionary changes. Our aim must be to ensure that all children, regardless of their parents' wealth, have access to a quality education and the same chance to achieve their full potential. To compensate for disadvantage, our best schools should be in the poorest areas. We must assist and encourage all schools—government and non-government—in innovating and sharing with other schools their successful ideas for improving teaching, developing new curricula and utilising new learning technologies.

Creating the Knowledge Nation will depend largely on the professionalism and dedication of Australia's teachers. They are one of our nation's most important assets. We must value them and give them the resources they need to fully develop the nation's knowledge potential.

Achieving this will require the Commonwealth to play a far more direct and active role in improving outcomes in Australia's public schools. No longer can the Commonwealth afford to be a remote funder of primary and secondary education.

RECOMMENDATION 11

The Commonwealth and the States should overhaul and modernise Australia's schools by:

- increasing the proportion of Commonwealth money going to public schools and funding non-government schools on the basis of need;

- raising school participation through a targeted program that tackles the causes of disadvantage;

- creating more linkages and co-location between schools and universities, including ongoing teacher skill development programs and mentoring programs for disadvantaged high-school students;

- investing in the creation of a modern teaching profession through ongoing training and re-training programs, providing financial incentives to teachers to upgrade their skills and qualifications, and, in partnership with the States and Territories, raising the

standing of the teaching profession, particularly in critical areas of shortage such as science and maths;

- making ICT literacy a core component of learning alongside literacy and numeracy by providing ongoing training for teachers in the use of ICT in the classroom, ensuring there is a national educational Internet portal for all schools and members of the community to use, expanding 'cyber libraries', making Internet access more affordable for all schools, and encouraging schools to develop and share high-quality online curricula; and

- providing children, from kindergarten through to Year 12 with a variety of experiences, encouraging a spirit of curiosity, excitement and their capacity for conceptual thinking to make linkages, form judgments, and to feel a sense of empowerment in a variety of disciplines, including language, music, art, sport, mathematics and communications.

Coffs Harbour Senior College—a revolutionary approach to public education

Coffs Harbour Senior College (CSHC) is a part of the Coffs Harbour Education Campus which combines the senior college with a campus of the North Coast Institute of TAFE and a campus of Southern Cross University.

The senior college offers students access to a very wide range of facilities allowing for a variety of different approaches to study. It offers an adult-oriented learning environment in which students are encouraged to take greater personal responsibility for their own learning.

This approach has proven highly successful. Retention rates have improved markedly and in 1999 60 percent of CSHC's year-12 students won a place at university—a result twice the State average—and another 13 percent went on to TAFE.

Students have a wide choice of subjects for their year 12 Higher School Certificate (HSC) studies, including vocational courses which contribute both to their HSC studies and formal TAFE certificates.

For example, in 1999 the college developed new course arrangements allowing students to complete Information Technology and Child Studies courses and receive both credit towards HSC and a TAFE Certificate Level III.

Students can also take units from Southern Cross University—in areas like Information Technology—as part of their HSC.

End the tertiary education funding crisis

The most visible effects of our national investment crisis can be seen in our universities and TAFE colleges. Libraries are being overwhelmed, student:staff ratios have increased, and research infrastructure needs renewal. Funding pressures are forcing our universities to neglect core enabling disciplines within the fields of science, engineering, the social sciences and the humanities. Our universities and TAFE colleges need a reinvestment and modernisation strategy based on increased funding for core activities, new programs, such as those to boost online education, and incentives for people to enrol in key Knowledge Nation disciplines.

RECOMMENDATION 12

The Commonwealth should tackle the university funding crisis by:

- boosting the number of university positions by an amount necessary to meet industry needs and maximise Australia's capacity as a Knowledge Nation by 2010;

- significantly increasing overall public funding of universities, including base operating funding, so they can continue to provide quality education and attract the best academic staff;

- improving staff development opportunities in universities;

- providing more incentives for people to study science and mathematics;

- reviewing HECS to ensure it does not act as a financial barrier to students, particularly mature-aged students and those from lower socio-economic backgrounds; and

- ensuring that all universities have the capacity to identify their own priorities and specialities from within the suite of national priorities and not be forced into a one-size-fits-all model.

A stronger vocational education and training system

VET has two functions in a Knowledge Nation—improving equity and enhancing innovation.

The overwhelming majority of those who will be in the workforce in ten years time are existing workers. If these workers are to participate in the Knowledge Nation rather than be condemned to increasingly temporary and insecure employment, there must be specific initiatives to increasing their access to vocational education and training. Such employees need access to education and training to improve their capacity to adapt to technological and workplace change and improve their opportunities in the labour market.

As a recent report has stated, VET plays a vital role in enhancing innovation by ensuring that those who actually make products and provide services have skills and knowledge to translate innovation into real productivity gains. Despite this, VET has not been included in the Howard Government's innovation statements.[40]

RECOMMENDATION 13

Australia's vocational education and training system should be strengthened by:

- increasing funding to TAFE, targeted towards strategic industries and skills and those in the community who are in danger of being excluded from the Knowledge Nation;

- ensuring that employers increase their level of investment in employee training that will lead to national qualifications;

- requiring companies restructuring their business to provide adequate notice and allow staff time off to participate in recognised education and training;

- improving vocational education and training in the workplace by adequately resourcing vocational education and training at the industry and enterprise level and further developing industrial partnerships through Industry Training Advisory Boards and the Australian National Training Authority; and

- creating strong quality assurance mechanisms for vocational education.

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40 V Fitzgerald (March 2001) *Skills in the Knowledge Economy: Australia's National Investment in Vocational Education and Training*, The Allen Consulting Group p1

Invest in early learning

The Taskforce believes that if Australia is to become a Knowledge Nation we must invest in all our citizens from the earliest possible age.

We have the capacity to make the Knowledge Nation vision a reality for all Australians born in the twenty-first century.

This requires a government that focuses on the early years of each Australian child's life.

The latest neurological research shows that the most sensitive period of brain development in children occurs in utero and in the first three to six years of life. This early period of brain development is critical to the wellbeing of our community; not just in physical and mental health, but also in literacy and numeracy.[41]

Research also shows that health and early relationships with caregivers influence infant brain development. The evidence suggests that children who lack at least one attentive and consistent caregiver, such as a parent or skilled child-care provider, are at risk of suffering severe and long-lasting developmental problems.

The message coming from the growing literature on early childhood development is clear. What happens in the first three years of a child's life strongly influences that child's performance at school, whether he or she will work and in what kind of job.

The lesson of the research is that if governments want to enhance children's life chances they must promote affordable, quality childcare that provides a positive early childhood experience. Governments should also aim to help parents balance work and family life, and provide other supports where appropriate, ranging from financial assistance, family services, and parenting advice.

There is now overwhelming evidence that if you get the platform of child and family services right you have fewer adults who cannot read, fewer spending time in prison and fewer without work. Australia should not waste talent and lives in this way. The evidence suggests that each dollar invested upfront can save up to seven dollars in the long run.[42]

Unfortunately, Australia currently lacks an integrated set of Commonwealth, State, and Local Government-funded services for children and families. It needs such a strategy now.

RECOMMENDATION 14

The Commonwealth Government should develop a comprehensive National Early Assistance Strategy for Australia's children and families, encompassing all levels of government and local communities. This strategy should be developed with the State and Territory Governments and be designed to deliver services such as:

■ effective and accessible high-quality childcare and early childhood education, especially in lower income areas, in both the cities and the country, which enables parents to balance work and family life and promotes early childhood development;

■ home visiting, or similar outreach programs for families with newborn children;

■ linked family and community centres;

■ locally responsive social security and employment services;

■ linked community health services; and

■ coordinated information and support services, including telephone advice lines for parents.

Rebuild the ABC

The Knowledge Nation is not just about education and industry; it is about deepening and broadening the culture of the whole community. To be an intelligent country, boundaries have to be pushed and the conventional wisdom challenged. Commercial networks do not seek to do this, and the ABC cannot do it well enough in its current emaciated state. The task requires the existence of a well-funded and independent national public broadcaster.

The most effective way to achieve this is to adequately fund the ABC, enabling the creation of new Australian content, boosting the production of educational programs in science and the humanities, and making the ABC a leader in the digital TV revolution.

RECOMMENDATION 15

Provide an adequate level of funding for the ABC as the quintessential Australian portal and to ensure a well-resourced, genuinely independent and truly national public broadcaster. In particular, to ensure that adequate funding exists for the production of popular, original, world-class Australian drama, comedy and current affairs programming that may not otherwise be commercially self-sustaining in small markets such as Australia.

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41 MN McCain and JF Mustard (1999) *Reversing the Real Brain Drain: Early Years Study Final Report.* Toronto, Canadian Institute for Advanced Research p7

42 Schweinhart *et al* (1993) *Significant benefits: The High/Scope Perry Preschool Study through age 27.* Ypsilanti, MI: High/Scope Press

A plan to tackle the 'brain drain'

Every year thousands of highly educated young Australians leave Australia to work abroad, and many educated people migrate to Australia. Australia benefits enormously from this two-way exchange. Not only do we gain many new skilled workers, Australian researchers return with valuable experience, knowledge and commercial contacts that can be used to the benefit of the nation.

Despite this, the Taskforce believes that more must be done to encourage more Australian researchers to return home. While Australian Bureau of Statistics (ABS) figures show that Australia is numerically a net importer of skilled professionals generally,[43] we are losing too many quality business people, academic and scientific researchers in key fields because of lack of opportunities here, and too few are returning to share their experience and contacts. For instance, nine Australian medical researchers, including Nobel Laureate Professor Peter Doherty, work in just one American research institute—the St Jude Children's Research Hospital in Memphis, Tennessee. We need them and thousands of others like them to return to Australia. We also need many scholars, researchers and business people of international calibre and from other nations to choose Australia as a place to live and work.

The brain drain problem will only be fully addressed in the long term by creating a vibrant Knowledge Nation with dramatically increased levels of funding and research activity. Turning around the drain of talented Australian business people overseas will also be a long-term exercise that will depend on our ability to create competitive new industries that can offer high rewards. However, the difficult nature of this exercise cannot be an excuse for doing nothing. Urgent action is needed. To start the process, Australia needs a concerted public and private sector campaign to get more Australian-educated researchers in key fields to return home.

Other countries such as Ireland and Canada have tackled this problem by creating joint public and private funded commercial research positions and university research chairs. Australia should adopt a similar approach.

RECOMMENDATION 16

The Commonwealth should create an inventory of all recent Australian graduates with research degrees who are living abroad, and a register of resumes and contact details for private sector employers. It should also create at least 1000 additional publicly and privately financed commercial and university research positions to enable those wanting to return to Australia to do so and to attract leading scholars and researchers from other countries and researchers to move to Australia to live and work.

A National Information Policy

Equitable access to information is a prerequisite for an inclusive Knowledge Nation. Access to information in Australia is currently very poor. Too much information is not publicly available, and much of what is made available through agencies such as the Australian Bureau of Statistics is prohibitively expensive. Many universities and scientific businesses and organisations cannot afford to purchase access to the world's scientific, humanities and social science databases.

Australia needs a National Information Policy to ensure access and equity in securing knowledge and to guarantee that information is available as a public good, outside commercial exploitation. Our principle should be that information paid for by the Australian people through their taxes should be readily available to all Australians.

As a part of this, all Australian students, academics and researchers should have access to the leading research databases across all disciplines, including those in digital form, through a coordinated funding approach to national information infrastructure. This access should also include all universities, TAFE colleges and major public libraries.

In the era of lifelong learning, all citizens need access to knowledge and information throughout their lives. Every citizen should have access to the world's knowledge through an online virtual bookshelf easily accessible through public libraries, educational institutions and at home via the Internet.

RECOMMENDATION 17

There should be a National Information Policy to ensure access and equity in securing knowledge, to set out the rules by which information will be available as a public good, outside commercial exploitation, and to provide the basis of public policy that will be applicable to new technological developments. This policy should ensure that:

- There is wide public access to the world of knowledge, including leading scholarly journals and other publications, through public libraries, education institutions and at home via the Internet, provided to the nation through the aggregation of the Commonwealth and the State's purchasing power.

- Important ABS data is free of charge to those who need it.

- There is adequate public consultation and debate on ethical and human rights issues, including disability access, privacy and security, which arise as we move towards a society where more confidential information than ever before may be in an accessible electronic form.

43 ABS 3412.0, February 2000.

A Population Policy

In the face of increasing global competition for knowledge and skills, Australia should develop a national population policy that plans for future skill needs in existing and emerging industries and builds the right age profile for future economic development. Shorter-term immigration programs must be an addition to, not a substitute for, developing the knowledge and skill capacity of Australia's existing population.

To maximise our human capacity, we must value the contributions of everyone and reject the prevalent negative connotations of ageing. Australia has about 2.3 million older citizens in the Third Age who are physically fit, mentally alert, and not welfare dependents. We must recognise people in the Third Age as an underused resource with much knowledge and wisdom to contribute to the creation of a Knowledge Nation.

RECOMMENDATION 18

Australia must adopt a National Population Policy that is based on a national, rational debate about Australia's carrying capacity and the implications for resource use; relies on an adequate database drawn from the cadastre; and distinguishes population policy (inevitably long term) from immigration practice (decisions made year by year). As a matter of urgency, visa processes for highly skilled scientists and technicians must be streamlined and overseas students with sought-after skills must receive greater encouragement to remain in Australia. Australia should also do more to use the experience and knowledge of people of the Third Age.

Improve the position of the humanities, social sciences and the arts in Australia

In becoming a Knowledge Nation, Australia must not adopt an overly instrumental approach. If we are to become an innovative society as well as a modern economy, we must not replace the richness of a broad and deep education for 'knowledge' that concentrates only on science and 'skills', important though these are. The education system must remain broad and encourage basic as well as applied research, and the humanities as well as the sciences and skills training. Vocational courses, too, should emphasise problem solving and communication skills in a broad social, cultural and economic context, in addition to teaching basic competencies. The pressures of commercialisation must not be allowed to weaken the intellectual integrity of our universities. Every school and tertiary institution should be enabled to participate in scientific and technological education, and also to study the ethical and environmental implications of these developments.

Unfortunately, over the past decade the relative position of humanities and social science faculties has deteriorated. Student:staff ratios in the humanities and social sciences have increased by 19 per cent and 14 per cent respectively. There are few entry-level positions for academics due to an increasing casualisation of the academic profession, leading to the loss of a whole generation of humanities and social science researchers. The humanities' share of ARC funding for Large and Small Project Grants has declined.

The picture is illustrated by looking at the changes in the number of teaching staff between 1990 and 2000 in the departments of history and philosophy in the universities that comprise the 'Group of Eight' (Australian National University, Adelaide, Melbourne, Monash, the University of New South Wales, Sydney, The University of Western Australia, and Queensland) (see Table 11).

TABLE 11: Teaching staff at the Group of Eight universities 1990–2000

Departments	1990 teaching staff	1995 teaching staff	2000 teaching staff
History	200	174	139
Philosophy	65	89	72

Source: the Commonwealth Universities Handbook for 1990, 1995–96 and 2000.

While not of themselves definitive evidence, these figure suggest a clear trend—there has been a dramatic fall in full-time employment in these disciplines, especially since 1995.

The expansion of the university system to create a Knowledge Nation must include a corresponding improvement in the position of the humanities and social sciences.

The Howard Government's neglect of the arts, most significantly through cuts to the Australia Council, the ABC, and film and television, has put great pressure on one of Australia's most innovative and creative industries.

There was not one mention of the creative industries—the arts—in the Howard Government's innovation statement. Governments must recognise the importance of authors, journalists, historians, poets, playwrights, designers, software developers, dancers, composers, musicians, visual artists and others to 'innovation' and the 'knowledge economy'.

These creative industries need to be nurtured through adequate public funding.

RECOMMENDATION 19

The humanities, social sciences and creative industries in Australia should be strengthened by:

- creating extra entry-level positions for a new generation of humanities researchers and lecturers in our universities;

- a reasonable share for the humanities and social sciences of funding increases for research through the ARC;

- creating partnerships in the humanities and social sciences to explore the commercial application of these disciplines and boost the creation of educational content;

- a renewed national effort to boost second language training;

- strengthened government support for the arts and creative industries through funding for the ABC, the Australia Council, the nation's galleries and other important public institutions; and

- humanities and social science representation on the Prime Minister's Knowledge Nation Council, which will replace the Prime Minister's Science Engineering and Innovation Council (PMSEIC) (see Recommendation 20).

New government structures to implement change

One of the factors holding back the creation of a Knowledge Nation is the failure of government to coordinate policies across departments and between Commonwealth, State and Local Governments. To assist the Prime Minister in the task of leading the creation of a Knowledge Nation (see Recommendation 1), Australia needs a whole-of-government approach to this problem. New structures will be needed, but these must occur within the context of a greater coordination effort within and between governments.

An important first step should be making the Prime Minister the Minister for the Knowledge Nation, supported by a cross-cutting Knowledge Nation Unit in the Department of The Prime Minister and Cabinet to develop and implement cross-departmental programs towards an agreed Knowledge Nation strategy.

Government advisory structures must be changed to provide the Prime Minister and the government generally with wider sources of advice and help make connections. As a starting point, a Prime Minister's Knowledge Nation Council with participation by scientists, educators and researchers across the knowledge spectrum, manufacturers and experts from emerging industries should replace the existing PMSEIC. This must be done in the context of a strong effort to build additional linkages between government departments and State, Federal and Local Governments.

Creating the Knowledge Nation will need a coordinated effort between Commonwealth, State and Local Governments to improve education outcomes, solve environmental problems, maximise the benefit to the nation of investment in emerging industries, and ensure that all parts of Australia benefit. To achieve this goal, the Council of Australia Governments (CoAG) must be given a wider role.

RECOMMENDATION 20

To drive the creation of the Knowledge Nation across government(s) the Commonwealth should:

- adopt a whole-of-government approach to the creation and commercialisation of knowledge;

- elevate the importance of science within the Commonwealth Government and make the Prime Minister the Minister for the Knowledge Nation;

- broaden PMSEIC into a Knowledge Nation Council, with the full resources of a Knowledge Nation policy unit within the Department of the Prime Minister and Cabinet; and

- ensure that CoAG maximises the overall benefit to the nation of strategic investment in knowledge-based infrastructure, including school funding, university research investment, environmental management, and public health provision and research.

APPENDIX: LIST OF SUBMISSIONS

GLOSSARY

Appendix: List of Submissions

Submissions were received from the following individuals and organisations:

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- Australian Vice Chancellors Committee
- Group of Eight Universities
- Australian Academy of the Humanities
- Australian Academy of Science
- Australian Academy of Technological Sciences and Engineering
- Federation of Australian Scientific and Technological Societies (FASTS)
- Australian College of Education
- National Tertiary Education Union
- Australian Manufacturing Workers Union
- Emeritus Professor Peter Karmel, AC, CBE, FAHA (ANU)
- Professor Emeritus Sir Gustav Nossal, AC, FAA, FRS (Melbourne)
- Professor Peter Doherty AC, FAA, FRS, Nobel Laureate (Tennessee)
- Dr Don Lamberton (ANU)
- Dr Joe Baker, OBE (Qld and ACT)
- Emeritus Professor David Yencken, AO (Melbourne)
- Colin Steele, Librarian (ANU)
- Jan Fullerton, Director General, National Library of Australia
- Emeritus Professor Hugh Stretton (Adelaide)
- Dr Peter Ellyard, Preferred Futures Pty Ltd
- Adrian Farrell, Principal of Woodlawn Marketing Services

Glossary

bioinformatics
a new field of research involving the use of computers to process, store and manipulate biological data, in particular, genomic and proteomic data

cadastre
a National Inventory or Knowledge Bank. The cadastre would provide a national picture of Australia's physical and human resources, both nationally and regionally and link the research bases of the Commonwealth and States, including the Census and the National Land and Water Resources Audit

dematerialisation
the decline in energy, hardware and materials as a share of world trade, for example, the use of e-mail rather than conventional letter delivery by post

digital divide
the gap between those who have access to the benefits of information technology, such as access to the Internet, education, and new employment opportunities, and those who do not. For some citizens the technology brings the promise of inclusion, opportunity and wealth; for others, greater isolation and increased poverty

functional genomics
identifies the mechanism by which proteins control cell functioning in all forms of life

genome
the full complement of genetic information that an individual organism inherits from its parents, especially the set of chromosomes and the genes they carry

genomic profiling
decoding the genetic basis of pathology, thus enabling medical researchers to move beyond the description of diseases to more effective mechanisms for diagnosis and treatment

knowledge nation
a nation of highly educated and skilled people that uses its knowledge resources in a coordinated way to create new industries, revitalise existing industries and tackle large scale problems like disease, social inequality and environmental damage

nanotechnology
technology that relates to the manufacture of microscopic objects

new economy
an often misunderstood term for the economy of the knowledge age. Sometimes misleadingly contrasted to the 'old economy', it includes both emerging industries (like ICT, biotechnology and environmental management) and existing industries which are in the process of being transformed by the application of knowledge (like mining and manufacturing)

photonics
the use of particles of light to communicate, store and process information, including optical fibre networks

proteomics
a new science in which scientists seek to identify and understand the function of all the proteins in the human body

supercomputer
a computer designed to perform calculations as fast as current technology allows and used to solve extremely complex problems. Supercomputers are designed to work on a single problem at a time, devoting all their resources to the solution of the problem

third age
the post-retirement stage of life