

Western Australian

Technology & Industry

Advisory Council

Annual Activity Report

July 1998 – June 1999



WESTERN AUSTRALIAN
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL



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TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

ANNUAL ACTIVITY REPORT

JULY 1998 – JUNE 1999



WESTERN AUSTRALIAN
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

Hon Hendy Cowan MLA
Minister for Commerce & Trade;
Regional Development; Small Business
Parliament House
PERTH WA

Dear Minister

On behalf of Council I am pleased to submit the annual Activity Report for the Western Australian Technology & Industry Advisory Council (TIAC) for the year ending 30 June 1999, for your information, and subsequent presentation to Parliament in accordance with Section 26 (1) and Section 26 (2) of the Industry and Technology Development Act 1998.

Council has also reported through the Department of Commerce & Trade's Annual Report and Financial Statement in accordance with Section 26 (3) of the Industry & Technology Development Act 1998 in compliance with Section 62 of the Financial Administration and Audit Act 1985.

Council acknowledges the valuable support given to TIAC by both your office and the Department of Commerce & Trade.

Yours sincerely

□

JOHN THOMPSON
CHAIRMAN

1 July 1999

For and on behalf of

Mr Rex Baker
Dr Lesley Borowitzka
Dr Mike Carroll
Ms Leslie Chalmers

Mr Robert Meecham
Mr Richard Muirhead
Dr Nigel Radford
Mr Bruce Sutherland

Prof Tony Tate
Prof Lance Twomey
Mr Lloyd Zampatti

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1 Introduction

The Technology and Industry Advisory Council (TIAC) was created by legislation in 1987 (Technology Development Amendment Act - No. 32 of 1987) and was continued under Section 20 of the Industry & Technology Development Act 1998.

TIAC was preceded by the Technology Review Group 1978-83, and the Science, Industry and Technology Council (SITCO) 1983-87.

Council is made up of representatives from various sectors of the State's economy who, in terms of the relevant Act, use their varied background and experience, to provide independent policy advice to the Minister so as to make a significant contribution to the development of strategies relating to the State's economic development.

Members of the Council are appointed, by the Minister, under Section 22 of the Industry & Technology Development Act 1998 so as to be representative of the interests of the people of the state. A list of members is provided in Appendix 3.

TIAC reports through the Minister to Parliament under Section 26 (1) and Section 26 (2) of the Industry & Technology Act 1998.

TIAC reports under the Financial Administration and Audit Act 1985 through the Department of Commerce and Trade as per Section 26 (3) of the Industry & Technology Development Act 1998.

2 Objectives of the Industry and Technology Development Act 1998

The objectives of the Industry and Technology Development Act 1998 under Section 3 are:

- 1 to promote and foster the growth and development of industry, trade, science, technology and research in the State;
- 2 to improve the efficiency of State industry and its ability to compete internationally;
- 3 to encourage the establishment of new industry in the State;
- 4 to encourage the broadening of the industrial base of the State; and
- 5 to promote an environment which supports the development of industry, science and technology and the emergence of internationally competitive industries in the State.

3 Functions of the Western Australian Technology and Industry Advisory Council

The Council, under Section 21 of the Act is required to:

- 1 provide advice to the Minister, at the initiative of the Council or at the request of the Minister, on any matter relating to the objects of the Industry and Technology Development Act 1998; and
- 2 carry out, collaborate in or produce research, studies or investigations on any matter relating to the objects of this Act, including matters relating to –
 - a) the role of industry, science and technology in the policies of government;
 - b) the social and economic impact of industrial and technological change;
 - c) employment and training needs and opportunities relating to industrial, scientific and technological activities in the State;
 - d) the adequacy of, priorities among and co-ordination of, scientific, industrial and technological activities in the State;
 - e) methods of stimulating desirable industrial and technological advances in the State;
 - f) the application of industrial, scientific and technological advances to the services of the Government; and
 - g) the promotion of public awareness and understanding of development in industry, science and technology.

4 Outcomes

Council's functions can be divided into two main areas:

1 Provision of Ministerial Advice

The advisory role to the Minister on the objectives of the Act and the encouragement, promotion and use of technology in the State centres around three key activities:

- a) the development of reports on issues pertaining to the Act and the role of science industry and technology development in the state. Council's reports are subjected to a public consultation phase before recommendations are submitted to the Minister;

- b) the analysis of reports written or commissioned by various national and international technology and economic development focused organisations and when appropriate, the submission of recommendations to the Minister on strategies relevant to Western Australia, and;
- c) Council's participation on various State advisory and funding committees or councils.

Report Activity (July 1998 - June 1999)

In its advisory role to the Minister, Council has:

- a) completed the public consultation on a report titled "From Mines to Minds: Western Australia in the Global Information Economy" and submitted its recommendations to the Minister;
- b) completed and launched for public consultation a report titled "Western Australia's Minerals and Energy Expertise: How can it be optimised: - *Growing the R&D Sector*";
- c) commenced a background paper titled "In an International Context: Is there a case for positive assistance programs, within an industry policy framework, for the Western Australian Manufacturing Industry?"

Copies of TIAC's reports are available in the Parliamentary Library, State Library, the Universities' Libraries and on the Internet at www.wa.gov.au/tiac.

Copies of the Executive summary of the two completed reports, "From Mines to Minds: Western Australia in the Global Information Economy" and "Western Australia's Minerals and Energy Expertise: How can it be optimised: - *Growing the R&D Sector*" are detailed later in this report.

Participation on State Advisory and Funding Committees and Councils

Council has accepted invitations for representation and participated on:

- a) the State's Co-ordination Committee on Science and Technology;
- b) the Steering Committee for the CSIRO National Centre for Petroleum & Mineral Resources Research;
- c) the State Funding Advisory Committee;
- d) the State's Information and Communications Policy Advisory Council;
- e) the Western Australian Department of Training's WestOne Reference Committee;

- f) the Commonwealth Government's Joint Science, Technology and Innovation Agencies and Advisory Bodies of Australia and New Zealand Biannual Meetings.

2 Promotion and Public Awareness Raising Activities

Council's promotional and public awareness raising programmes consist of two main types:

- a) the 2020 Breakfast Seminars, which are short, economic development focused, information dissemination events; and
- b) the Science & Technology Forums which were established under the State's Science and Technology Policy in April 1997 in order to "raise the awareness of science and technology in the community and increase the community's input in the State's directions in Science & Technology".

2020 Breakfast Seminars

In the 1998-1999 financial year, Council conducted four 2020 Breakfast Seminars which were focused on the following themes:

- a)
 - i) "Research and Development: The Role of the State Government in Attracting External Funding".
 - ii) "Past, Present and Future of the CRC Program" - Dr Geoff Vaughan, Chairman, CRC Committee.
- b) "Innovative Partnerships for Regional Development" – Mr Gatjil Djerrkura, Chairman of ATSIC.
- c)
 - i) "From Mines to Minds: Western Australia in the Global Information Economy".
 - ii) "... and who is minding the farm?" - Mr David Crawford, Chairman, Export Grains Centre Ltd.
- d)
 - i) "Western Australia's Minerals and Energy Expertise: How can it be optimised: *Growing the R&D Sector*".
 - ii) "Managing the Resource Industry in a Global Knowledge Economy" – Mr Malcolm Richmond, Managing Director - Development, Hamersley Iron Pty Limited

Science and Technology Forums

TIAC has conducted five Science and Technology Forums in the regional centers of Karratha, Kalgoorlie, Northam, Mandurah and Albany. The theme discussed at the regional centres was "Technology, Skills and the Changing Nature of Work".

A further two events were conducted in Perth under the themes:

- a) “Wealth Creation in the Information Age of the Global Economy”;
- b) “Hollywood meets the Labcoats”.

The event “Hollywood meets the Labcoats” was targeted at family groups and in co-operation with Scitech, Murdoch University, STAWA, Western Australia Museum and National Science Week.

5 Financial Provisions

The expenses of Council are provided for under Section 15 of the Industry & Technology Development Act 1998 via the Western Australian Industry & Technology Development Account.

The 1998 - 1999 Budget was \$330,000.00 with an additional of \$80,000.00 specifically allocated for the conduct of Science & Technology Forums under Objective 3 of the State’s Science & Technology Policy.

6 Member’s Remuneration

Council member’s remuneration and allowances are determined under Section 24 of the Technology & Industry Development Act 1998 resulting in:

1	Chairperson’s Salary	\$40,000.00 (per annum)
2	Members Sitting fee – Non-Public Sector	
	Council Meetings	\$800.00 (per meeting)
	Other Meetings	Nil
3	Members Sitting Fee – Public Sector	
	Council Meetings	Nil
	Other Meetings	Nil

Council conducted ten Board meetings, 20 Steering committee meetings for the planning and developments of its reports, seven Science and Technology forums and four 2020 Breakfast seminars and participated in 15 meetings of other funding and advisory committees and councils.

7 Executive Staff

Council is provided with a full time executive staff of two officers seconded from the Department of Commerce and Trade. The current Executive Officer is Mr Earl White.

8 Financial Statement

TIAC reports under the Financial Administration and Audit Act 1985 through the Department of Commerce & Trade's Annual Report and Financial Statement.

9 Outlook for 1999 - 2000

Council's activities for 1999 - 2000 may be grouped into three main areas:

- 1 The development of three reports with working titles:
 - a) Export of Western Australian Education and Training: Constraints and Opportunities.
 - b) Biotechnology West: Strengths, Weaknesses and Opportunities.
 - c) The Drivers and Shapers of Economic Development in WA in the 21st Century.

and the completion of the background Paper "In an International Context: Is there a case for positive assistance programs, within an industry policy framework, for the Western Australian Manufacturing Industry?"

- 2 The completion of its regional Science and Technology forum programme "Technology, Skills and the Changing Nature of Work", the publication of a report on these workshops and the continuation of its Perth based Science and Technology programme.
- 3 Development of two one hour video programmes on its Science and Technology forums and distribution of them via the Westlink / Telecentre network in order to encourage further regional participation in its awareness raising activities.



WESTERN AUSTRALIAN
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

**From Mines to Minds:
Western Australia in the Global Information Economy**

(Summary and Recommendations)

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Background

The Western Australian Technology & Industry Advisory Council (TIAC) has conducted a number of studies relating to the various aspects of the State's Information & Communications Sector. The last two reports titled *Towards an Information Infrastructure Policy for Western Australia - The Business Aspect* and *Telecommunications Deregulation: Is Western Australia Prepared?*, contributed to the State Government's decision to establish the Office of Information and Communications Policy Advisory Council (ICPAC) within the Department of Commerce and Trade which reports to the Cabinet Standing Committee for Information and Communications Issues.

The Minister requested TIAC to participate in the Information and Communications Policy Advisory Council (ICPAC) and TIAC commissioned this report as part of its contribution to that process. The report presents a series of options for the development in Western Australia of a strong, sustainable, globally-oriented indigenous information industry which has been leveraged off the State's world class minerals & energy sector and includes recommendations on the action required to achieve these options.

For the purposes of this report, the term "information industries" covers a wide range of activities, including electronics manufacturing, computing and telecommunications platforms, office equipment, consumer electronics and information and entertainment services.

The preparation of the report and associated consultation with industry has taken place over the past nine months. During that time there has been a number of substantial initiatives undertaken by the State Government in this area, and several of the projects outlined in this report have already been, or are in the process of being, implemented.

Vision

To build an enterprising online culture in Western Australia as the foundation for an integrated and sustainable indigenous network of globally-oriented Information Industries

About the Title - From Mines to Minds

The document argues that the mining and resource industries are already very heavy gatherers and users of information, at the same time being vital sectors within the State's economy. It is logical to use resource industry participants, as many companies already have, as the basis for global expansion of the State's Information Industries. Furthermore it is not intended to suggest that mining and resource applications should be the limit of this vision since the opportunity exists for generic technologies and techniques developed by going through "From Mines to Minds" are able to be applied elsewhere.

Executive Summary

1 Global Issues

Developed economies are moving into the fastest growing sectors - information and knowledge-based industries and Elaborately Transformed Manufactures (ETM). Globalisation is driving increasing levels of competition in all markets.

Information and Communication Technologies (ICT) are significantly changing the relationships between regions; between centralisation and decentralisation.

The global information economy will be made up of big winners and big losers.

Management is becoming significantly more challenging as the "steady state" era ends and is replaced by far greater volatility.

These changes can be seen as a shift from the economics of transformation (epitomised by mass production) to the economics of transaction.

2 National Issues

Multi National Corporations (MNCs) dominate Australia's Information Industries.

Australia is a heavy consumer of (predominantly imported) Information and Communication Technologies (ICTs) which it does not use very productively. It has a massive trade imbalance in ICTs without always generating the productivity returns.

Australia has an extremely low level of Information Industry exports.

3 Western Australian Issues

Western Australia has a narrow economic base dependent on commodities. Its resources sector performs very strongly.

The value of resource commodities has been falling over time and continues to fall.

Western Australia is a significant exporter of highly skilled talent.

Western Australia has a good track record of innovation...

...as with the rest of the country, it has an appalling record in commercialisation.

The State Government accounts for 40 per cent of Western Australia's ICT consumption.

The Western Australian Information Industry is 0.1 per cent of the global industry.

4 Western Australia's Strengths

The State's resource sector operates at world's best practice and is globally oriented.

The Western Australian ICT companies have a (relatively) strong export performance earning more than twice the national average from overseas.

Distance and isolation create domestic imperative to seize opportunities enabled by ICTs.

Strong technical base, with a well educated, English-speaking workforce.

Time Zone precisely eight hours from the UK and from the west coast of North America.

Strongest growing State economy, although exports are dominated by resources.

Attractive physical environment.

5 Driving Forces

To achieve the State's potential will require transitions on a number of fronts. These can be summarised under the following headings:

- | | |
|----------------------|---|
| Social and Economic: | The transition from a provincial to a global perspective on the part of the business community and government. |
| Technological: | To reconceptualise the Resource Industries as heavy users of information and that this can become the foundation of a business(es) in its own right. |
| Environmental: | Addressing the impact of ICT's on the State's physical isolation, in particular in relation to: <ul style="list-style-type: none">• the effect on various industries' value chain, and;• building online relationships for social and global business development. |
| Political: | Encourage the Federal Government to reframe its Taxation and Industry Policies to take account of the Global Information Economy. |

Recommendations

As has been mentioned, work on this report has taken place over the past nine months. During that time there have been a number of substantial initiatives undertaken by the State Government. It has been gratifying that several of the projects outlined in this report have already been, or are in the process of being, implemented.

The Federal Government has also been active during this time. It is not the intention of this report to suggest there should be any duplication between State and Federal initiatives but that they continue to cooperate in this area. To provide a framework the recommendations have been organised under major headings: Awareness and Demonstration Projects, Support, Education and Training, Infrastructure, Networks and Alliances, Data and Information, and Lobbying Initiatives.

1 Awareness and Demonstration Projects

It is recommended that:

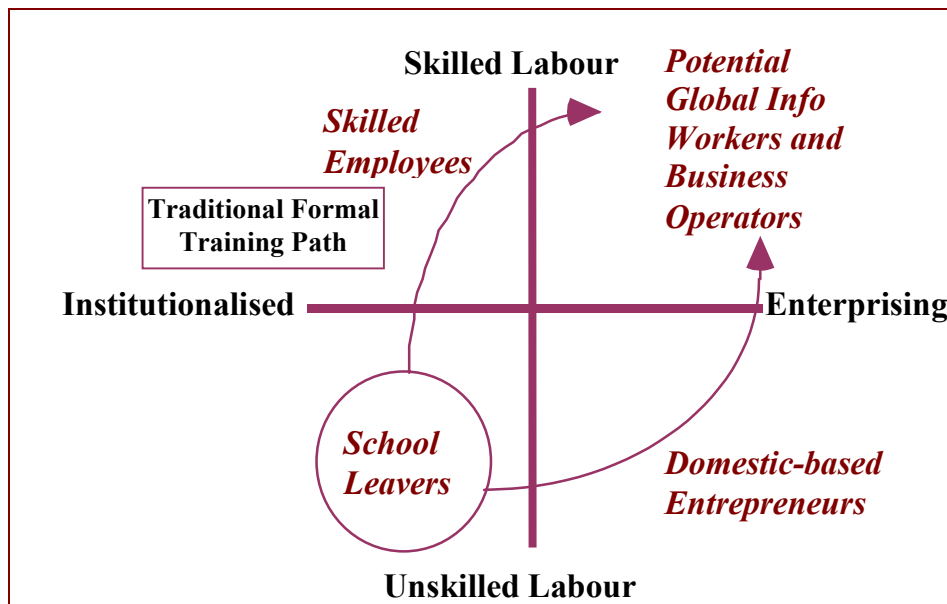
- a) The State Government fund a *Western Australia Online 2000* program to:
 - raise education and awareness;
 - get businesses online, and;
 - develop industry by industry online cases studies.
- b) The State Government establish an "Investment Ready" Program for small to medium sized Information Industry companies.
- c) The State Government initiate a Public Sector Distributed Management Project.
- d) The State Government should work with the Local Government sector to encourage it to act as a facilitator and lead user within its community of ICTs and information services.
- e) In conjunction with office developers the State Government encourage the development of High Bandwidth Serviced Offices - aggregating the telecommunications needs of small information companies to one location to overcome telco pricing strategies to enable them to access high bandwidth telecommunications at competitive prices.
- f) The State Government facilitate the establishment of Information Industry Business Incubators - as above (High Bandwidth Serviced Offices) with the addition of online business advise and support.

2 Support

- a) The State Government facilitate and encourage the marketing and use of Information Brokers by its agencies and appropriate Western Australian firms.
- b) The State Government implement a program for Online Process Reengineering - an AusIndustry-like program in which firms are subsidised to have consultants review their operations and recommend online alternatives which will increase their efficiency.
- c) The establishment of an Online Business Division within the Small Business Development Corporation to provide advice to aspiring online companies and existing firms interested in developing an online presence. This Division should have at its disposal personnel capable of giving advice on global and national markets.
- d) The State Government should investigate short comings in Western Australia's seed funding market and examine potential strategies to overcome these difficulties eg.:
 - support the establishment of a Western Australian branch of a national Venture Capital firm, and/or;
 - establish a Western Australian branch to a foreign investment bank(s) and/or VC.

3 Education and Training

- a) The State Government establish an organisation to coordinate and support research, education and training in the Information Economy generally and in distributed work technologies and techniques in particular.
- b) Global Information and Knowledge Industry Entrepreneurship Training be introduced for High School, TAFE and University level students.
- c) The State Government work urgently with Western Australia's educational institutions (at all levels) to develop a strategy to address the Skills/Enterprise Gap.



4 Infrastructure

- a) The State Government undertake a feasibility study of the potential costs and benefits of attracting a Semiconductor Fabrication Plant to the State.

While this study is undertaken a strategy to provide services to the Semiconductor Fabrication industry be developed (possibly through TimeShift and other distributed work techniques) to:

- gain greater knowledge of the industry's dynamics;
 - to generate short-term revenue;
 - to better position Western Australia for subsequent negotiations for a plant in the future, and;
 - as part of a wider campaign to encourage graduates to stay while continuing to develop their skills and to attract emigres back to Western Australia.
- b) The State Government undertake a feasibility study of the potential costs and benefits of attracting a Short-run, Contract Manufacturing Plant to the State to assist in the development of Elaborately Transformed Manufacturing (ETM) companies.
- c) The State Government oversee the development of a Narrow Bandwidth WWW Standard. This would allow for World Wide Web pages to be efficiently transmitted over narrow bandwidth links.

Government Agencies would be required to conform to this standard to service regional and rural users.

5 Networks and Alliances

- a) The State Government facilitate Western Australian Information Industry exchanges to enhance links between the Western Australian telecommunications, computing and content industries.
- b) The State Government implement a Western Australian Prodigal Sons and Daughters project. This would include developing a database of expatriate Western Australia Information workers and develop strategies to attract them back to the State.
- c) For those who cannot be induced to return home, strategies need to be developed to incorporate them into Western Australian information networks for indigenous firms to use their knowledge.
- d) The State Government should initiate a "Know Who" project which encourages the involvement of knowledgeable new arrivals (to Western Australia) into local industry networks.
- e) The State Government should initiate a study into the best means of developing and maintaining globally dispersed Feed-back Loops. This study must acknowledge the difficulties distance and isolation pose for the State's Information Industry firms in remaining abreast of market intelligence in a fast-moving global industry and develop strategies to address these limitations.
- f) The State Government should facilitate Global Partnering: encourage the partnering of Western Australian Information Industry firms with complementary organisations overseas to enhance information flows.

6 Data and Information

- a) The State Government should identify opportunities for import replacement by Western Australian Information companies.
- b) The State Government should “map” the Western Australian Information Industries to identify clusters. This database must also be maintained.
- c) The State Government should benchmark Western Australia’s online progress in comparison with other states and comparable overseas regions in terms of:
 - online primary, high school and tertiary education programs;
 - telecommunications services and costs;
 - public sector online initiatives;
 - number of online business start-ups and their longevity, and;
 - management understanding of online threats and opportunities.

- d) The State Government should identify the Western Australian industries most vulnerable to the Global Economy and develop strategic approaches for them to counter this threat.
- e) The State Government should identify Western Australia's Skills Surpluses
- f) The State Government should identify service industry clusters for most suited to TimeShift distributed work.

7 Lobbying Initiatives

- a) Lobby the federal government and industry groups for reform of:
 - the existing capital gains tax legislation to support the establishment and development of fast growth Information Industry companies, and;
 - the current sales tax regime (in light of the general acceptance of developing world acceptance of the Internet as a tax free zone).



WESTERN AUSTRALIAN
TECHNOLOGY & INDUSTRY ADVISORY COUNCIL

**Western Australia's Minerals and Energy Expertise:
How can it be optimised? –**

Growing the R&D Sector

June 1999

(Summary and Recommendations)

Executive Summary

The Western Australian Technology and Industry Advisory Council (TIAC) commissioned this study in order to develop policy options that would support the growth of a resources-based knowledge-intensive industry sector in the State. Its approach has been to explore options for growing this new element of the Western Australian economy on the strength of its existing industry, based on minerals and petroleum extraction.

The recommendations that follow are founded on study of the current position of Western Australia's resources-focussed knowledge-intensive industry. Under its Terms of Reference, this study has examined the strengths and weaknesses of the industry, and the possibilities and impediments facing it. The outcome was sobering. Despite the evident potential, the numbers show that the minerals and petroleum R&D industry is weak, and what little exists is fragmented. Furthermore, the links between researchers and the demanding first customers for new technology are tenuous.

The root of the problem is a lack of the knowledge-based infrastructure that the existing primary industry is drawn to use. The present minerals and petroleum industry has not taken on, and cannot be expected to accept, the role of providing this infrastructure. Moreover, by sourcing its knowledge requirements elsewhere, the extractive industry appears capable of maintaining its own competitiveness while contributing little to the growth of the State's own knowledge base.

It is therefore argued that there is a vital role for government action to change this, paralleling its earlier investments in physical infrastructure that drew the extractive industry here in the first place. Indeed, without government action there is no evidence that the envisaged development of the new knowledge-intensive sector will occur at all.

It is therefore concluded that strategic public infrastructure investment is required to provide the physical and intellectual capital to grow the knowledge base to support the new industry. This needs to be supplemented with strategic public support for research intensive projects that will accelerate its growth. In this, the conclusions of the present study are aligned with the recommendations made in the 1994 report of the Western Australian Parliamentary Select Committee on Science and Technology.

The actions of the British and Norwegian Governments in capitalising on their North Sea petroleum resources provide models of how this might be achieved. Actions of governments in resource-rich States and Provinces in North America also provide pointers. However, as Western Australia is exceptional among economically advanced States in its dependence on extractive industry, specifically local initiatives are needed.

The sweep of the tasks envisaged transcends the boundaries of individual government departments. Furthermore, present investment is required to ensure future dividends, so that the time-span of the venture – at least fifteen years – extends beyond that of individual governments. For these reasons this report recommends the establishment of a statutory fund, the Western Australian Minerals and Petroleum Industries Strategic Technology Fund, to provide the necessary capital. It recommends that this fund be placed under the accountable management of a statutory body, the Western Australian Minerals and Petroleum Industries Strategic Technology Council, which would be charged with the task of recommending the investments required to achieve the envisaged growth. Where appropriate, it is recommended that the proposed Council channel its investment and support through existing mechanisms.

APPENDIX 2

Growing the new knowledge-intensive industry is not simply a matter of setting a policy framework. It will require active management. It is recommended that the Council be established expeditiously with an initial fund from Consolidated Revenue of \$5 million for its first year, so that it can begin its own learning. It is further recommended that the fund under management should be increased over four years to the point where its annual allocation becomes equal to 0.1 percent of the value of minerals and petroleum production in Western Australia and adjacent offshore waters. On present figures this amounts to about \$20 million per year.

A summary of the specific recommendations from this study appears at the end of the synopsis, which follows the table of contents.

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Synopsis

The following synopsis presents the vision for a resources-based knowledge-intensive industry in Western Australia, reveals the gap between this vision and present reality in the minerals and petroleum R&D industry in Western Australia, and highlights policy options by which the State Government might bridge this gap.

S1 The Vision

The minerals and energy industry – primarily metallic minerals, petroleum gases, and the downstream processing of raw materials that they yield – currently drives the Western Australian economy. However, the industry is fundamentally extractive and the lesson of history is that the cost of continued exploitation of natural resources eventually rises. Production ceases when the continuing drift to an ever-higher position on the industry cost curve becomes untenable.

Even the greatest resources do not last forever. It was recently announced that the last mine at Broken Hill is about to close. This will make a total life of about 120 years for what was, by any standards, a fabulously large mineral deposit.

The challenge for governments is to use the State's natural endowment productively to grow a sustainable economic base.

In launching the recent Western Australian Technology and Industry Advisory Council (TIAC) report "From Mines to Minds" (TIAC, 1999), TIAC Chairman John Thompson stated:

"There is a growing consensus that Western Australia's future lies with the new knowledge intensive industries and in those parts of other industries such as mining and primary production which are knowledge-intensive.

Western Australian policy makers should, therefore, be concentrating on how to ensure that the major pillars of the State's economy, namely primary production and mining, make the knowledge-intensive transition successfully.

The requirement is for nothing less than world class knowledge intensive mining and primary production industries and the debate should be focussed on how this can be achieved."

This was a most timely reminder. But it has been said before. The fact that Western Australia's current boom surge in minerals production started in the mid 1960s may well have made the State deaf to what was already obvious to others at that time. In 1964 Lyndon Johnson, then US Vice-President, wrote: "We are entering a new industrial revolution. Bulky natural resources and vast populations matter far less than inventiveness and skill." (Johnson, 1964).

The State Government has acknowledged this in developing the State Science and Technology Policy. However, a greater strategic focus on the minerals and petroleum R&D sector is needed.

APPENDIX 2

Developing a State with great mineral and petroleum wealth is a challenging task that has tested governments throughout history. Many have found the blessing to be very mixed indeed, through its distortion of the wider economy.

The basic choice for the government seeking to diversify an extractive resource-driven economy is to:

- 1 invest the money, while it is there, in quite different areas, deemed to have higher potential, which entails “picking winners”;
- 2 invest money in broader, but closely related, areas that have the two-fold potential for growth in their own rights, and to extend the period in which the extractive resource industry can remain competitive – in effect, “backing winners”.

To select the first of these would be a courageous decision indeed. The second holds the promise of stronger, more organic growth, more deeply rooted in a receptive environment. However, the time when a free choice between the two options was possible may well have passed.

The recent flurry of “junior explorers” leaving the mining business to invest in Internet-based ventures is at once an indicator of two critical economic factors.

- 1 It demonstrates a greater confidence in the future of knowledge-based industry than in the future of commodities.
- 2 It is a clear warning sign for an economy that relies on continuing exploration success to offset the declining position of resources already being exploited.

Between 1990 and 1997 the percentage of their mineral exploration budgets spent overseas by Australian companies has risen from 26 to over 42 per cent. Furthermore, these exploration budgets have fallen by over 25 per cent. Australia – Western Australia included – is becoming a relatively less attractive area for exploration.

There is a problem, and it is not far away. A dual thrust inherent in the second option is now an imperative.

The first policy thrust is to encourage the growth and the competitiveness of the industry. The State will grow from policies that:

- 1 avoid forcing current producers further up the cost curve;
- 2 encourage investment by new producers;
- 3 ensure that the State remains prospective for exploration.

The first two of these three issues are substantially addressed by policies already in place. The third requires further attention; it is essentially a matter of public good.

The second policy thrust is to use the presence of a world-class commodity industry to grow a parallel knowledge-intensive industry that at the same time:

- 1 supports the minerals and petroleum industry in its competitive drive;
- 2 develops into an export industry in its own right.

In this way the State will gain from minerals and petroleum commodity exports and from minerals and petroleum knowledge exports.

In the course of the current severe downturn Western Australian iron ore exporters have had to accept lower prices, but they have held market share and maintained the State's position as the world's largest exporter of this commodity. This has only been possible because they are operating low on the industry cost curve, even though Western Australia's iron ore resources are far from being the best in the world – a reality that should be more widely appreciated. For other operators, at the higher end, the outcomes have been far worse. The part played by deep knowledge in maintaining this competitiveness is absolutely critical.

Moreover, knowledge industries can continue long after the resources on which they were originally based have declined in significance. Ballarat University still produces mining engineers, yet hardly one in ten of these gains employment as a graduate in Victoria. Oklahoma continues as a major centre of oil industry R&D long after the time when that State was at the centre of the industry.

The vision can be achieved. The leading roles assumed by British and Norwegian technology suppliers in the NorthWest Shelf developments testify to the effectiveness of public policies in the development of the North Sea fields. The United Kingdom and Norway recognised in the North Sea an unexpected bonanza and reacted accordingly. There is, however, a disturbing sense that Western Australians may have come to believe that the State's mineral and petroleum resources will last forever.

S1.1 How is the Goal to be Reached?

The vision is of:

- *A growing, resources-led, sustainable, technology-based export industry.*

If it is to be achieved, something will have to be changed. Thirty years of extraordinary developments in the Western Australian minerals and petroleum production industry have *not* been matched in the minerals and petroleum *knowledge* industry.

Research and development is the fundamental driver of knowledge-intensive industry. However, the intensity of minerals R&D – R&D expenditure in relation to the value of production – undertaken in Western Australia is only about half that for Australia as a whole. The amount of petroleum R&D undertaken in the State is very small indeed.

This does not imply that the minerals and petroleum industry is not doing “enough” R&D. It simply reflects the observation that the industry chooses not to do much R&D in Western Australia.

But every dollar spent elsewhere represents a loss in the State’s potential for the growth of a minerals and petroleum knowledge industry.

The major reason that the industry chooses to go elsewhere for much of its R&D is that the State’s present R&D infrastructure can only serve a small part of the industry’s needs. This has hardly affected the industry; it has shown that it is willing to go anywhere in the world for its R&D. However, this does not help to grow the local R&D infrastructure. The industry states, and has demonstrated through its choices, that it is not willing to invest in infrastructure that it does not own.

The same applies to education – the foundation of the knowledge industry. Western Australia continues to source over 60 per cent of its graduate mining engineers from outside the State. Yet each graduate that the State does not produce means that lost opportunity to grow the knowledge sector and its associated research capability.

There are, however, promising pointers to what is possible. In particular, the State possesses recognised strengths in R&D support for the field of minerals and petroleum exploration. This has spawned a local knowledge-based service industry, and growing capacities in data visualisation and exploration instrumentation. There are also growing strengths in mining software. These developments hint at the potential growth available.

The State’s initiatives in securing the establishment of major CSIRO facilities in its Divisions of Minerals, of Exploration and Mining and of Petroleum Resources have been critical in developing these local strengths.

These moves are in full accord with recommendations in the 1994 Western Australian Parliamentary Select Committee on Science and Technology (“The Thomas Committee”, Thomas, 1994), which led to the formulation of the State’s Science and Technology Policy. They represent significant steps in the direction recommended in this study.

The advantages of homegrown technology businesses are enormous. In contrast to local businesses, foreign-owned technology companies operating in Australia tend to concentrate on the domestic market rather than on exports, and on average only invest about half as much in R&D (in terms of sales) as do local companies (Sheehan, 1998)

S1.2 Who Should Pay for an R&D Infrastructure?

The prevailing view is that the user should pay. But who is the user? The industry has demonstrated that it is willing to pay the global market rates for its R&D. But while it is willing to buy from an “R&D shop”, it is not willing to build the shop as well.

The argument accepted here is that the State stands to benefit from the new knowledge-based industry. The industry benefits – on a user-pays basis – when it accesses the knowledge-intensive infrastructure. But fundamentally the State is using the existing industry as the initial market for the new knowledge-intensive one.

Thus, it can be argued that the State is the user, and the State can therefore be expected to pay.

In the past it has largely chosen not to, and the result is what exists today – and this is not very much.

In distinct contrast, Western Australia governments have long been major supporters of agricultural R&D, for which detailed and critical analyses have confirmed the high returns generated by this public investment. There is no suggestion that agriculture and the minerals and petroleum industry are directly comparable. However, the point is that the agriculture-based knowledge-intensive industry received State support through a prolonged formative period. That the Government can now choose to reduce the level of its own investment in agricultural R&D demonstrates the maturity of the R&D infrastructure that this investment has helped establish in the industry.

Thus the thesis advanced here is that the State should play an active role in growing the R&D infrastructure, and in creating the conditions for the growth of a resources-focused knowledge-based industry.

S1.3 How Might the State Invest?

The position taken in this paper is that the Western Australian State Government should greatly increase its investment in building the infrastructure to support and nurture a resources-based knowledge-intensive industry.

Many reasons can be advanced for Government investment. The Industry Commission (1994) has catalogued classical economic justifications for intervention as the existence of:

externalities or spillovers (the investment is “leaky”);
risk and uncertainty (it is “risky”);
indivisibility (it is “lumpy”);
information asymmetry;
the common pool problem applies.

It also refers to evolutionary and new growth theories. These theories have been reviewed recently by Bryant and Wells (1998), underlie the developmental options canvassed by Marceau, Manley and Sicklen (1997) and have also received support in a recent article in *The Economist* (Anon., 1999).

Public investment in the area of profit-generating businesses is more problematic.

The contention here is that the present, and future, State governments should set a clear policy on knowledge infrastructure investment. The measure of the success of such a policy is, however, the industrial growth that it induces, not the profits that it might earn –or more likely it would *not* earn – as a business enterprise in its own right.

The point may be made by analogy. Thus, the success of investment in extending the Mitchell Freeway to the new city of Joondalup is measured by the growth of that city. Unlike the Melbourne City Link road project, which joins established areas, it could not be expected to show a profit through the imposition of tolls for its use. Charging a toll that slowed the development of Joondalup would be counter-productive to the State's intended purpose in funding the extension.

Western Australia has been prepared to make large infrastructure investments – railways, roads, ports and dams – to develop industries with physical outputs. Now is the time to do the same for the new knowledge industries.

This call has been made before. The first recommendation of the Thomas Committee (Thomas, 1994) was for a Science and Technology Policy that would be “supportive of science and technology infrastructure in selected current and prospective high potential areas.”

Further, this first recommendation included the statement that “Policy programs need stability and continuity.” Indeed, a clearly articulated and firmly maintained purpose is essential if infrastructure investment is to be allowed to generate its potential benefits.

The prevailing view in the minerals and energy industry is that the fate of the State Mineral Processing Laboratory is an example of the dangers of changing priorities in mid-course. In essence, this view sees that, through policy change, what had been conceived as an infrastructure investment was subsequently assessed as operating business enterprise. It was then transferred to CSIRO when it failed to show the operating profit that had not been its intended purpose.

Infrastructure investment decisions call for high standards of judgement. Building a road to where no one wants to go would still be a *bad* investment, notwithstanding that it might be an infrastructure investment. Infrastructure investment makes sense when it is made in an environment conducive to growth.

Whatever its other benefits to the State, Rio Tinto's spending of tens, even hundreds, of millions of dollars on its HIs melt® ironmaking development at Kwinana has made remarkably little difference to the State's wider capacity to undertake R&D in this field. Injected into a research environment with little capacity to provide useful assistance, the HIs melt development has turned elsewhere for such external assistance, as it needed. It appears that when its development phase in Western Australia is completed its departure will leave barely a mark on the local research infrastructure.

In contrast, Alcoa's development of its Kwinana facility into that group's world R&D centre for alumina production is deeply and organically implanted in a local research environment that had the capacity both for immediate support and for synergistic growth.

The most immediately promising areas for infrastructure investment in resource-based knowledge intensive industry are those where there are particular local needs that are less easily met by knowledge suppliers elsewhere. Thus, the deep regolith cover over some 70 percent of the State's surface is more a problem for resource exploration in Western Australia than in most other prospective regions. Similarly, the problems of exploiting the North West Shelf – hot, cyclone-exposed, marine environments, unstable sea floor, and high contents of carbon dioxide in the petroleum gas – require local solutions.

The *duplication* of intellectual resources already available overseas might initially seem unattractive. But why should not local infrastructure be developed to challenge and *surpass* them? There was a time when it would have been considered mad to set up a shipbuilding industry in competition with Britain. But it was done – indeed it has been done successfully in Western Australia – and where is British shipbuilding now? Where a market has been established there is an opportunity. The current decline in a number of the former leading centres of minerals education and research means that there may be no better time than now to seize the initiative in resources knowledge.

Why could not Western Australia become the Silicon Valley of resource knowledge? In capital-intensive physical developments such as those for minerals and petroleum production, the danger is that the equipment, its financing, and the embodied knowledge can be sourced externally, leaving the State only the supply of labour and the rental value it can extract from the resource. In knowledge industries the local rewards can be much greater – the average income in Silicon Valley is about twice that for the United States as a whole.

United States Federal Government and State support of research infrastructure has been fundamental to the emergence and continuing success of its high-technology industries.

The decision on what infrastructure to invest in is an issue for government, not for the present extractive industry. The existing industry cannot necessarily be expected to have an interest in the growth of a new sector of the economy. As an industry that can already access knowledge resources located elsewhere, it may well see no great advantage in local infrastructure.

However, if the new infrastructure is world class – as it must be – there is every reason to suppose that industry will indeed use it, and this use will lead to the development of the knowledge-intensive sector.

It is beyond the scope of this paper to make specific recommendations on any particular investment. This is an ongoing task requiring active management.

S2 The Present Reality

In short, the present study found a gulf between the vision and the present reality.

S2.1 The Nature and the Methodology of the Study

This study has been conducted under the guidance of the Steering Committee named in Appendix R, using the services of the consulting team also listed there. The committee has aimed at developing policy options designed to grow a technology-based industry with high export potential. The vision is of:

- *A growing, resources-led, sustainable, technology-based export industry sector.*

The committee worked to the following four Terms of Reference:

- 1 Identify, from an industry perspective, the strengths and weaknesses in Western Australia's minerals and energy R&D infrastructure and expertise.*
- 2 Identify, from an industry perspective:*
 - i) factors influencing demands for research services;*
 - ii) structural or process impediments to research funding;*
 - iii) opportunities for greater collaboration between the industry and research providers.*
- 3 Identify potential markets and opportunities by which the State may derive benefits from its investments in minerals and energy R&D through the export of services.*
- 4 Provide policy options for the State Government to consider so as to ensure the growth of a world-class Western Australian minerals and energy R&D Sector.*

The report starts by describing some of the particular characteristics of the minerals and energy industry that are especially relevant to this study. It then proceeds to deal with each of the first three Terms of Reference in turn.

Once an understanding of the present situation was achieved, policy development, the fourth of the Terms of Reference could be addressed.

S2.2 The Present Situation – Major Findings

The methodology described above established a firm base on which to build a set of policy options designed to help achieve the Committee's vision. This task was tackled in five main ways, through:

- An examination of the major groupings of players within the industry (Appendix A).

- A survey of persons involved in R&D in all the major sections of the minerals and energy industry, and those in research groups that focus on the industry. The survey combined canvassing opinions on the major issues relevant to the Terms of Reference and the collection of more quantitative information to supplement the official statistics. The details are provided in Appendices B to G.
- Examination of official data on the current extent of minerals and energy R&D in Western Australia. The analysis is described in a series of Appendices from H to L.
- Analysis of how research funding provided by the Western Australian Government through the Mineral and Energy Research Institute of Western Australia (MERIWA) has been applied (Appendix L).
- Consideration of policies adopted elsewhere including the case study of the North Sea oil development described in Appendix M.

Various other specific enquiries were made as required. Appendices N and O highlight some important characteristics of different elements within the industry in relation to their R&D requirements.

The report starts with an introduction and, in Chapter 2, describes some of the particular characteristics of the minerals and energy industry that are especially relevant to this study. It then proceeds to deal with each of the four Terms of Reference in turn.

There is sense, discernible, if not quite tangible, in the descriptions in Chapter 2, that the minerals industry is at a point of profound change. The larger, more globally oriented firms appear to be moving towards a mode of operation more like that which characterises the petroleum industry. The current severe downturn in almost all commodities simultaneously – almost unprecedented in the experience of those in the industry – has wrought profound changes. Companies have restructured, downsized, and outsourced.

The situation in exploration is particularly significant. Large companies are leaving exploration to smaller “exploration juniors”. But these can hardly get the capital to explore, let alone conduct R&D into exploration techniques. And the companies that have quit exploration are hardly likely to maintain their interest in improving its effectiveness.

The emphasis in the production side of the industry has moved to human and organisational capital, away from operating technology, as the driver for competitiveness. The prolonged price pressures have resulted in deep organisational and cultural changes. When prices rebound the industry will not return to the way it was before.

The conclusions reached regarding each of the first three of the Terms of Reference are summarised below. The policy options called for in the fourth are then reproduced, in full, as a set of five specific recommendations, some having a number of sub-points.

The first of the Terms of Reference covered strengths and weaknesses; the third dealt with opportunities. However, since there is at present only a very much embryonic resources-based knowledge industry in Western Australia, it had not seemed necessary specifically to address threats. Yet there is indeed considerable threat.

The threat to the growth of the knowledge industry *per se* is that unless its infrastructure is developed it will simply not progress much beyond its present state. Moreover, its weakness poses a real threat is to the development of the State. The increase in the proportion of the total exploration budget being expended overseas is even more serious than it first appears. Australian exploration is being increasingly concentrated on developments around resources already being exploited, rather than on little-explored regions. The prospectivity of the State, and the effectiveness of exploration tools for dealing with its challenging terrains, are increasing in question. Both require increasing amounts of R&D that is focussed specifically on local needs.

S2.3 Conclusions Regarding the First Term of Reference

The first of the Terms of Reference was to identify, from an industry perspective, the strengths and weaknesses in Western Australia's minerals and energy R&D infrastructure and expertise.

The conclusions to this part of the study, described in detail in Chapter 3, can be summarised briefly.

The State has only a limited number of areas of minerals and petroleum R&D strength, notably in geological exploration, in hydrometallurgy, in aspects of geomechanics and offshore engineering, and in environmental issues.

Moreover, even within the areas where capability exists, there is considerable fragmentation and a marked lack of integration into coherent and marketable entities. Furthermore, much of the capability is not readily accessible to industry.

The businesses operating in Western Australia disproportionately source their R&D elsewhere. The fundamental reason for this is a lack of relevant R&D infrastructure in the State.

S2.4 Conclusions Regarding the Second Term of Reference

The second of the Terms of Reference was to identify, from an industry perspective:

- i) factors influencing demands for research services;*
- ii) structural or process impediment to research funding;*
- iii) opportunities for greater collaboration between the industry and research.*

This part of the study is covered in Chapter 4, but it is important to note that there is a sense that the demand for R&D in Western Australia has not as yet been properly tested. It is also critical to recognise the complex structure of the demand. There are distinct differences between the demand from production-focussed technology users, and the technology developers. Amongst the producers, there are differences in demand between operating divisions and corporate centres.

The most salient point is that most of the external R&D undertaken by the industry in Western Australia appears to be in response to research push – researchers with ideas looking for sponsors, rather than an industry with problems seeking solutions. This and the relative lack of R&D capacity are the main structural impediments to greater collaboration.

In order to make the most of opportunities the focus should not only be on increasing collaboration, but also on bringing about a cultural and structural change to develop a more commercially-focussed research environment in Western Australia.

S2.5 Conclusions Relating to the Third Term of Reference

The third of the Terms of Reference was to identify potential markets and opportunities by which the State may derive benefits from its investments in minerals and energy R&D through the export of services.

The investigation of this Term of Reference is described in Chapter 5. Perhaps the most important point is that there is no sense that the potential to export to the world minerals and petroleum industry is constrained by demand. The market is enormous. The limitations are related to the challenges of reaching the market.

However, an export business cannot be grown on the basis of one-off sales. A commitment to the long term, and a stable infrastructural base are pre-requisites. The weaknesses already noted are a cause for concern in this regard.

S3 Options for Public Policy

The situation today is that there has been little progress towards the future industry that TIAC envisages, and no signs that, with the continuation of present policies, the current slow pace of development is likely to change significantly.

Faced with this gap, and with the conviction that the vision is desirable, the question is: what might be done to accelerate the rate of development?

Extensive reference was made to the views of people active in the present minerals and petroleum industry, and the related R&D sector. However, the aim of the policy development task was focussed on an industry that currently exists only in embryonic form. As such there were relatively few voices that could to speak to this directly.

APPENDIX 2

In making recommendations the committee could look to examples where the knowledge-intensive transition had been achieved successfully, notably to the UK and to Norway. It was also guided by a conceptual framework for the development of a knowledge-intensive industry sector. This is outlined in Appendix P.

The policy options follow, therefore, from knowledge of what others have achieved, and the conceptual model that identifies gaps in the current sectoral structure. They do not represent an amalgamation of the views of those in the present industry.

Furthermore, they are conceived as policies to achieve a particular vision of the State's future.

It is far beyond the scope of this study to attempt to assess the relative desirability of all possible futures for the State.

In essence, these policy options intended to direct the first steps on a path towards the vision, are to:

- *Develop the State's R&D sector by growing its capacity to service the R&D needs of the local minerals and energy industry.*
- *Encourage the export of R&D-based services, technologies and products based on capabilities strengthened through meeting the challenges of servicing a demanding home market in the minerals and energy industry.*

Once the conclusion has been reached that there is a vital role that only Government can play in developing the local knowledge infrastructure, the policy development issue turns to one of how this can be achieved. This has been undertaken by first identifying the root causes of the present unsatisfactory situation, and then turning attention to how public investment might effectively address them.

S3.1 The First Root Cause of the Current Situation

The study of the first three Terms of Reference identified a deficiency in knowledge-based infrastructure as being at the root of the current unsatisfactory situation. Unless this is increased the envisaged benefits of the growth of this industry will not accrue to the State.

Study of what happened in the development of the North Sea oil fields showed what can be achieved through State intervention. The United Kingdom and Norway used a combination of policies to achieve growth of knowledge-based industries. Their more directive actions would, however, appear to be inapplicable in Western Australia at this time. On the one hand the Federal Government has not shown such an inclination – as documented in *A Sea of Indifference*, the report of the House of Representatives Standing Committee on Industry, Science and Technology (1998). On the other hand, the economics of the petroleum industry are almost the opposite of what they were in the mid-1970s, at the time of the OPEC 'Oil Shock'.

However, the actions of these governments in establishing and nurturing the knowledge base for resource discovery, development, extraction and processing can be duplicated. This indeed is the recommendation of the present study.

S3.2 The Second Root Cause of the Present Situation

Study of the first three Terms of Reference revealed a second deep-seated impediment to the growth of knowledge-based industry. This is the disconnect between researchers and demanding first customers of new technology. This is manifest in complaints voiced from industry that local researchers “lack business focus”, and corresponding expressions of disappointment from researchers that industry “lacks vision”. It would be wishful thinking to expect these parties to change their views; each complaint is valid from the point of view of the aggrieved party that makes it.

The reason for the dichotomy becomes clearer when the existing players are mapped against the framework for industry development (Appendix P). The complainants are addressing each other across a gulf. There is a critical shortage in Western Australia of entrepreneurial technology developers who occupy the space between research and industry “talking science to the researchers and business to industry”.

A strong commercially focussed technology-developing industry sector is a necessary complement to an enhanced R&D infrastructure. It is greatly in the State’s interest that this sector is developed.

S3.3 Managing Knowledge-Based Infrastructure Development

The infrastructure development recommended here is aimed at building a receptive and capable environment for the growth of knowledge-intensive industry. This is not the exact equivalent of building physical infrastructure, such as a highway. The particular difference lies in the fact that:

“the knowledge bases of apparently low and medium technology industries ... are in fact deep, complex, science-based and above all systemic (in the sense of involving complex and sustained institutional interactions).” (Smith, 1998).

Furthermore, the *knowledge base* is the product of dynamic and path-dependent processes. Its maintenance, growth and exploitation are therefore dependent on the effective, continuing and active management of the process. However, this is independent of the profitable use that the market may make of the *knowledge*. This has the important implication that management of the local knowledge base may lead to market opportunities not available otherwise or elsewhere.

Managing the growth of the local knowledge base – the essence of infrastructure investment in a knowledge-based industry – cuts across a range of areas covered by different government departments and ministries.

- It starts with education.
- It interacts directly with the science and technology policy functions of the Department of Commerce and Trade.

- It is vitally concerned with the State's own internal knowledge of the value and exploitability of its resources – a function of the Department of Minerals and Energy.
- It directly impacts on areas that are the responsibility of the Department of Resources Development.

Moreover, investment decisions imply the exercise of judgement, and a corresponding element of risk. In view of these factors there appear to be considerable advantages in charging the making of such decisions to an accountable body that it is separated from day-to-day political processes for the duration of its task.

The model advocated here is for a designated investment fund actively managed by an accountable statutory body. There are examples to draw on: the various Federal Government R&D Corporations, the Victorian Strategic Industry Research Foundation, etc.

But does the State need yet another such body? What of the Minerals and Energy Research Institute of Western Australia (MERIWA)? What, for that matter, of TIAC?

There is indeed a strong case for another body, which is referred to here as the Western Australian Minerals and Petroleum Industries Strategic Technology Council. None of the existing bodies have the combination of focus and cross-functional accountability that is required. And the role of this Council is distinct; it is specifically strategic. It should not replace the initiatives already in place. Indeed it is recommended that where appropriate its activities should be channeled through the effective existing pathways: MERIWA, The Resources Institute, and the Centres of Excellence program.

The Industry Commission's study on R&D policy (1994) recommended that diversity of mechanisms for R&D support should be encouraged. The uncertain relative efficacies of various types of funding mechanisms, and of the various funding bodies, mean that some redundancy within the system is desirable. There is logic to this. If governments are subject to criticism for their alleged inability to "pick winners", how could they at the same time be expected to choose a single policy option and a single delivery system for R&D support?

S3.4 The Tasks for the Proposed Council

The fundamental task of the new Council is envisaged as the making of recommendations for the strategic investment of a dedicated fund: the *Western Australian Minerals and Petroleum Industries Strategic Technology Fund*. It is recommended that this fund should be in addition to present separately targeted funding already available through MERIWA, the *Centres of Excellence* program, the Geological Survey of Western Australia, etc.

Three types of investment are envisaged:

- 1 Direct investment in strategic physical and human technology infrastructure, such as laboratories and testing facilities, together with their core staff.
- 2 Support for strategic research-intensive development projects

- 3 Funding of strategic initiatives recommended by MERIWA, the *Centres of Excellence* Program, and The Resources Institute, but which are outside the capacity of these entities to support from their internal resources.

Its own staffing need be no more than that required to decide on its investments and to ensure their accountable management.

The essential objective is that the new Council should start on its task as soon as possible. Managing the growth of a new industry is a hands-on task. The Council will have to evaluate its investment options and make its decisions based on the information available at the time; in other words it will have to *manage*. Further studies and econometric modeling based on the present infrastructure will not relieve the Council of this high accountability. The Council must learn, and it must have funds to start its learning.

How much funding it should have for its strategic investments will have a direct influence on how fast the new industry grows. The most important thing is that it should start; an initial sum of \$5 million is recommended for the first year.

The annual increment to the investment fund should eventually – in, say, four years – be set at 0.1% of the value of mineral and petroleum production in Western Australia and adjacent offshore waters. On current production this would amount to about \$20 million per year.

There is a rationale for recommending this value. The production side of the industry currently spends about 1 per cent of its revenue on R&D – sustaining its internal knowledge bases. The expenditure of a specific fraction of this amount on a public knowledge-based infrastructure should be sufficient to ensure that large proportion of the industry's R&D expenditure is attracted to Western Australia, providing an increased market for research and technology developers. The issue is the size of this specific fraction.

It is clear that spending very little public money, as at present, has not achieved this. At the higher end, investing an amount approaching that spent by the industry itself on R&D could be seen as a direct and unnecessary subsidy to the present production industry. The particular fraction that would produce the optimum result for State development cannot, of course, be known precisely. However, the figure of one-tenth – and hence the figure of about \$20 million per year is not unreasonable. It would be less than half the current State spending on agricultural R&D.

It is not difficult to envisage how this sum might be spent. For example, and without constraining the Council to these figures, a sum of \$2 million per year to strategic collaborative project funded through MERIWA, and \$4 million per year for strategic research infrastructure beyond the guidelines for *Centres of Excellence* program, could be envisaged. Another \$4 million per year might be used for specific commercialisation projects. The investment of the remaining \$10 million per year, on average, for 10 years would ensure the establishment and initial operation of five or six major units of developmental infrastructure. A proportion of this might also be used to attract established knowledge-intensive operations to relocate, or set up local operations. It is envisaged that the Fund would not have to expended completely in each year, but that it would be allowed to accumulate to fund larger projects.

It is, however, to be specifically emphasised that there is no suggestion that the State should somehow “seal its borders”. Part of the challenge to the new Council will be to extract maximum value out of its investments. In many instances this is will be through strategic alliances.

S3.5 Outcomes and Benefits to the State

The State will gain a knowledge-intensive industry sector. The benefit to the State will increase as this is more and more fully integrated into the local economy.

The first stage of the development will see an increasing capacity for local research providers to supply services of real value to the mineral and petroleum industry operating in Western Australia. This will in turn engender an increasingly commercial focus amongst researchers as local technology developers bridge the gap between researchers and the first commercial customers for new technology.

However, the leverage at this stage is still around one-to-one: R&D expenditure produces a new outcome. The first major point of leverage is in the second stage, where the knowledge spreads throughout the industry through wider sales of knowledge-intensive products, and of knowledge, through consultants.

The first stage is the direct product of infrastructure investment and project funding; it could be envisaged occurring within around five to seven years of investment. The second stage comes from the cultural change that a more commercial focus brings in its train. This would be expected to be noticeable within about ten to fifteen years.

These time-scale might appear long, but this is realistic in the light of the North Sea experience. A change in research culture over this length of time is also evident in the profound impact that the Federal Cooperative Research Centres scheme is making through its operation over the last decade.

Critically, the likely time-scale shows the need for a steadfast public purpose. Changing an economic base is not achieved within one or two terms of government.

The third stage of development will see customised products, flowing from an established local knowledge base, rather than from specific research *per se*. This is the stage that will see the State’s industry less dependent on “build to blueprint” and increasingly capable of sophisticated local engineering design input. At this stage the customer base broadens as the knowledge is less specifically tied to the research that led to its development.

Small scale developments in stages two and three are already flowing from research started around ten years ago in geophysical exploration techniques – one of the notable areas of R&D strength in Western Australia. Basic research is now embodied in commercial survey technology used across the industry – a stage two development. At the same time, the image analysis techniques that this entailed are finding application in the treatment of eye disorders – another area of high local capability. This combines a Stage-three development with a jump back to Stage-one, but in a different field.

The fourth stage of industry development is production for a mass market, extending beyond that of the original first customers. This is where the leverage on the original infrastructure investment can become enormous.

The local company Earth Resource Mapping provides an example of the transition from a Stage 1 initial provider of a technical solution – satellite image analysis for exploration – to a Stage 4 supplier of industrialised “shrink-wrapped” spatial information product valued by different users in different industries throughout the world. It is significant that the company acknowledges the essential role of public agencies, including CSIRO research, Federal Government R&D assistance, and export development support, in making possible its growth over ten years to its present self-sufficient status.

Development of individual products and services through all four stages is governed by laws of probability; only a few first stage products will reach the mass market stage, but they are the ones that can transform economies.

The chances of reaching a mass market with knowledge developed in Western Australia may well be increased through appropriate use of strategic partnerships, a course of action envisaged for the Council in its infrastructure investment role.

In short, these recommendations envisage ten to fifteen years of patient, accountably managed, strategic infrastructure and project investment, made through a variety of mechanisms. This approach acknowledges that it is impossible to pick the “winning” projects in advance. Instead, it will create an environment that encourages the germination of new business that will be able to compete in the global market.

The specific recommendations resulting from this study are listed in the following summary.

Summary of Recommendations

The fourth of the Terms of Reference was to provide policy options for the State Government to consider so as to ensure the growth of a world-class Western Australian minerals and energy R&D Sector.

These policy options are developed in Chapter 6 and are amalgamated here as a set of five specific recommendations, together with a number of sub-points. Suggestions as to how these recommendations might operate are provided in Chapter 6.

1 It is recommended that the State Government:

- a) establish the Western Australian Minerals and Petroleum Industries Strategic Technology Council;
- b) establish under the management of this Council, the Western Australian Minerals and Petroleum Industries Strategic Technology Fund.

1.1 The Council would be established by Act of Parliament, be accountable to a designated Minister, and would report to a Cabinet sub-committee of relevant Ministers.

1.2 The Council would be accountable for the development of strategic policies for the rapid growth of an R&D-based industry focussed on the technology required to ensure the continued attractiveness of mining and energy exploration, extraction and processing in Western Australia.

1.3 The Council would be responsible for the implementation of its strategies through management of the Western Australian Minerals and Petroleum Industries Strategic Technology Fund, and for the monitoring and reporting on the development of the industry and its benefits to the State.

1.4 The Council would consist of single representatives of each relevant Government Department, together with an equal number of external appointees and an independent Chairman, appointed in their own rights, and not representative of any enterprise or organisation.

1.5 The Western Australian Minerals and Petroleum Industries Strategic Technology Fund would be in addition to current funding and any future increases in internal State Government funding directed at the minerals and petroleum industry. It would be provided with an initial sum of \$5 million per annum, increasing to \$20 million per annum over four years, and thereafter indexed pro rata to the value of mineral and petroleum production in the State and adjacent offshore waters

2 **It is recommended that** the Western Australian Minerals and Petroleum Industries Strategic Technology Council be represented on the decision-making bodies of the Minerals and Energy Research Institute of Western Australia (MERIWA), the State *Centres of Excellence* Program and the Resources Institute.

2.1 *The Council would be empowered to recommend expenditure from the Western Australian Minerals and Petroleum Industries Strategic Technology Fund on appropriate strategic initiatives advanced by these bodies, but beyond either of their charters or their capacity to provide funding.*

3 **It is recommended that** the Western Australian Minerals and Petroleum Industries Strategic Technology Council be empowered to recommend investment from the Western Australian Minerals and Petroleum Industries Strategic Technology Fund in the development and, if appropriate, continued operation of infrastructure that it judges as having the potential to advance its strategic goals of industry growth.

3.1 *The Council would give due consideration to the industrial structures – and the associated knowledge bases – on which growth of the industry depends.*

3.2 *The Council would adopt a policy framework for minerals and petroleum R&D infrastructure support that ensures that its individual investment decisions contribute to an overall strategy of developing a competitive market in industry-focussed R&D services.*

3.3 *The Council would ensure that its investment decisions are followed through to achieve their intended strategic aims.*

4 **It is recommended that** the Western Australian Minerals and Petroleum Industries Strategic Technology Council consider this present report and determine the actions that it might appropriately take to address the issues raised herein.

4.1 *The Council would:*

- a) *establish, maintain and publish an accessible database of the skills, expertise and equipment of Western Australian R&D service providers addressing the needs of mining and energy exploration, extraction and processing;*
- b) *promote and publicise these capabilities;*
- c) *ensure the operation of a referral service through which industry can make contact with relevant providers of R&D services, extending to engineering development services.*

5 **It is recommended that** the Western Australian Government:

- a) maintain a high level of capability in the State's Geological Survey organisation;
- b) develop a high capability relating to the technology and economics of processing the State's mineral and petroleum resources.

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