Policy Choices in Industry and Technology - Joint Symposium with PCEK and AMC

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POLICY CHOICES IN INDUSTRY AND TECHNOLOGY

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INTRODUCTION

A number of reports dealing with industry policy have recently been published, among them those by Professor Helen Hughes and Professor Ross Garnaut for the Australian Government, and that of consulting firm Pappas Carter Evans and Koop for the Australian Manufacturing Council. In addition, in March 1990 ASTEC completed a study of the role of science and technology in Australia's future industrial development.

Although these reports all focus on the broad area of industry policy, they do so from very different points of view. They have stimulated a considerable amount of comment and debate about industry policy directions. In order to ensure that such comment and debate is well informed and acquainted at first hand with some of the source documents, ASTEC, Pappas Carter Evans and Koop, and the Australian Manufacturing Council conducted a seminar in Canberra on 15 August 1990. The seminar was for an invited audience, mainly of senior public servants and policy advisers. It focussed on the principal outcomes of the ASTEC and Pappas Carter Evans and Koop reports; papers were presented by Professor H L Martin, Chairman of ASTEC, Mr H Evans, a partner of Pappas Carter Evans and Koop, Mr P Laver, Corporate General Manager, Technology and Development, BHP Co. Ltd, and Mr J Burke of the Australian Manufacturing Council. The Minister for Science and Technology, the Hon. Simon Crean, MP, kindly delivered the keynote address.

These papers are gathered together in this publication, to allow them to be available to a wider audience. The debate about directions for industry policy is a continuing one, and ASTEC and Pappas Carter Evans and Koop hope that the seminar, and this publication, will make a worthwhile contribution to it.

The speakers

Mr Alex Dix, AO
Mr Dix is Chairman of the New South Wales Science and Technology Council, and Chairman of Smiths Industries Pty Ltd. He holds, or has held, directorships or chairmanships of a number of major Australian companies, and is also chairman or a member of a range of bodies advising government, including the National Museum of Australia Council and the Consultative Committee on Relations with Japan.

The Hon. Simon Crean, MP
Mr Crean is Minister for Science and Technology, Minister Assisting the Prime Minister for Science, and Minister Assisting the Treasurer. Before entering Parliament in 1990 he was

2 Garnaut, R 1989, Australia and the Northeast Asian Ascendancy, Report to the Prime Minister and the Minister for Foreign Affairs and Trade, AGPS, Canberra.
President of the Australian Council of Trade Unions.

Professor Ray Martin, AO, FAA
Professor Martin is Chairman of the Australian Science and Technology Council and Professor of Chemistry at Monash University. He was Vice-Chancellor of Monash University for ten years until 1987. As well as being a teacher, researcher and educational administrator, Professor Martin has served on the Winston Churchill Memorial Trust, the Council of the Victorian College of the Arts, and the Australian Vice-Chancellors Committee.

Mr Peter Laver
Mr Laver is Corporate General Manager, Technology and Development, for BHP Co. Ltd. His responsibilities involve BHP research, new business ventures and investments, including the development of new business outside Australia. His earlier positions in the BHP group of companies have included General Manager Transport, General Manager BHP Steel International, and General Manager Mt Newman Mining (WA). Mr Laver is Chairman of Koppers Australia Pty Ltd, a Council Member of the Australian Maritime College, and a former president of the Institute of Metals and Materials Australasia Ltd.

Mr Joe Burke
Mr Burke is Acting Assistant Director of the Australian Manufacturing Council Secretariat. He has also served as Executive Officer of that Council and the Forestry and Forest Products Industry Council. He has been a Ministerial Adviser to the Victorian Government and an education officer for the Vehicle Builders Union.

Mr Ralph Evans
Mr Evans is a Director and founding partner of Pappas Carter Evans and Koop. He has been a consultant since 1971, working in many countries and on a wide range of industry, government and international issues. His consulting work has mainly focussed on corporate and business strategy and its extension into industry policy advice for governments.

Acknowledgments

Thanks are due to the seminar Chairman, Mr A J Dix, AO, and to the speakers at the seminar. Mr Ian Shortt of the ASTEC Secretariat and Mr James A Lumbers of Pappas Carter Evans and Koop organised the seminar. They were assisted by Mrs Marg Hall and Ms Karen Curtis of the ASTEC Secretariat. Pappas Carter Evans and Koop provided financial support for the seminar.

The seminar proceedings were edited for publication by Ms Chris Pirie, with assistance from Mrs Marg Hall.

Further copies of these proceedings can be obtained from ASTEC, PO Box E439, Queen Victoria Terrace ACT 2600 (Telephone (06) 2715655).
OPENING REMARKS
Mr Alex Dix,
Chairman, New South Wales Science and Technology Council

It is almost a cliche to open a seminar by saying 'It's timely', but this seminar undoubtedly is. The issues being discussed, and hopefully acted upon, are crucial to our future, to its being prosperous, peaceful and democratic. They also mesh with other essential changes in contemporary Australia, especially in education and in the attempts to review governmental procedures, structures and responsibilities that have been announced recently by the Prime Minister and some of the Premiers.

Although this seminar is timely, time is not on our side. The consequences of events in the Middle East will be neither short-lived nor irrelevant to Australia and the issues we are considering. We must find ways of accelerating and facilitating essential and acceptable change. Will we leave this seminar with any clear view of specific things that we can do to contribute to this process? This seminar will focus attention on these questions.
There are three basic themes I wish to develop: the first is the concept of the 'clever country'; the second is the question of workplace culture, to which the Pappas Carter Evans and Koop report makes considerable reference; the third is the context in which the debate that Garnaut and Pappas Carter Evans and Koop represent is being conducted.

There is an underlying theme that Australia must realise better its assets and develop to the utmost the opportunities that exist. Realising our assets is very important in the context of the 'clever country'. Australia is already quite clever in terms of its stock of intellectual knowledge and its scientific and research output. What we are not clever at is applying or commercialising to the best advantage that stock of knowledge. Often we discover, and someone else develops.

Underpinning much of the Government's efforts in science and technology is the need to examine the means by which we better apply the great national asset that we possess - our store of knowledge in the scientific, technological and research fields. If we succeed in our attempts to achieve a better application of our expertise we will have the capacity as a nation to overcome our two most pressing problems. The first problem is the need to become more competitive in terms of the global market, by using our research base and technological innovation to better value add and to develop leading-edge technologies. This is an economic problem, one that pertains to solving our balance of payments difficulties.

The second important issue confronting Australia involves the consequences of resource development - the sustainable development debate. Science and technology not only provide the means for developing a better understanding of the implications of the development of resources; it also has the capacity to provide solutions through sensible application.

The framework within which the Federal Government is encouraging the better application of this national asset base, our store of scientific knowledge, is one that tries to achieve linkages with industry. Among a variety of initiatives is the Cooperative Research Centres Program. In essence, this program is an attempt to achieve linkages in two ways. The first is by networking between research efforts, to create complementarity between specific strengths in similar areas of research. In the past Australia has not been terribly good at this, and much of our research effort has been fairly thinly spread. The second means of achieving linkages involves industry's involvement in deciding where the research effort should lead - the commercialisation phase. This is the essence of the Cooperative Research Centres Program.

A number of issues raised in the Pappas Carter Evans and Koop report relate to the question of whether or not we need to target our research effort in Australia. The Cooperative Research Centres Program does not set out to target, but the committee with responsibility for making decisions in relation to the first round of applications has been asked to assess whether we are in fact too 'thinly spread' and if so how we might best address this weakness.

The question of how we achieve linkages between industry and the research effort also raises the issue of the need for brokers - people who have an understanding of activities in the scientific and industrial fields, who can motivate others and try to achieve practical
outcomes. In a sense, the committee process of the Cooperative Research Centres Program is performing this function, but if we are serious about making the jump to the application phase it may also be necessary to identify people specifically for that job.

The third area that is very important is venture capital. One great national asset that can be exploited is exclusivity to government-owned, government-funded research and development. If a mechanism can be found whereby access to that exclusivity can be created, then we start to approach the question of where we find the funds. Take superannuation in Australia: in general, these funds are managed for, say, twenty to thirty years. Thus the institutional investors who manage superannuation funds have a responsibility to think in the long term rather than the short term. If we can identify this national asset, if we can devise a mechanism that may give exclusivity to it, we have the potential to tap a source of capital and so enable much of this development to take place.

On the international front, there are significant opportunities to develop our strengths in fundamental long-term research through the strengths of our trading partners, particularly Japan and South Korea. Their strength lies in application, but they know they need a sound base in fundamental long-term research because they must develop the leading-edge technology. Technology transfer is no longer going to guarantee those countries continuing growth. We must trade sensibly with our asset, not just give it away, and that means that we must come to grips with the intellectual property argument, we must think strategically about our international trading alliances and use our science and research bases more appropriately.

Australia's strengths in the sciences and the research field - in, for example, biotechnology, the pharmaceutical industry, ceramics, information technology (software, servicing and training), and the aerospace industry - are recognised internationally. The point is that our trading partners need our established expertise in fundamental long-term research and we must learn to trade our skills effectively.

The second theme, and a matter of great importance, is industrial relations and the workplace culture. In this regard, Australia is developing another great asset: a significantly changed attitude on the part of the trade union movement, a preparedness to embrace an enterprise focus in which wages policy is not just about distribution, but about wealth creation, and in which wages policy is linked to productivity and efficiency gains and skills formation. Again the question is, How do we realise that asset? Much depends on the way in which management responds.

My view is that it is unproductive to try to reform industrial relations and the workplace culture in this country by tackling the structural side of things. What is needed is attitudinal change and process involvement, and then the structures will follow. The number of unions in an establishment is not important if there is a single agreement: a single agreement that binds the totality of the workforce. Obviously, it is easier to negotiate with a single union, but if that cannot be done and if too much time is spent focussing on the structure, the real point is being missed. What is necessary is to tap into the attitudinal change, the significant shift in position. The trade union movement never talked before about wages being linked to productivity; now it embraces the idea. It never talked before about the need to multiskill and to build skill formation and reward it accordingly; now it is talking about it. The question is, How well does management respond?

Finally, if this debate between Pappas Carter Evans and Koop, Garnaut et al. is allowed to degenerate into a stereotyping of people into interventionists and free marketeers, nothing will be achieved. In the abstract, given the current circumstances in Australia at present, free market would probably win over intervention. But the argument should not
be dealt with in the abstract: it is necessary to examine the circumstances in which Australia has developed, because the Government has in fact been prepared to intervene. The issue really is about the circumstances and the role the Government plays.

Numerous industries have been recipients of programs or ‘intervention’ as part of a development strategy. In the aerospace and information technology industries the partnership program has been very effectively used to waive offsets on the basis of a commitment from companies to industry development and R&D. As well, in the pharmaceutical industry there has been a preparedness to look at the pricing mechanism. In that industry, prices have always been viewed from a welfare standpoint rather than an economic one. Yet it is the economic standpoint that will determine whether there is investment, and there has been a preparedness to waive the welfare argument through the Factor F mechanism, which entitles people to charge a different price or recover a different price, under the benefits scheme, in return for commitment to manufacturing and R&D.

The accelerated depreciation argument put broadly by Pappas Carter Evans and Koop is doomed to failure if taken in isolation, even though the Government has on occasion been willing to embrace it. The Government has extended it in the ship-building industry, and it is a significant reason why we are now building vessels, along with the fact that manning and crewing levels within that industry have also been addressed.

Accelerated depreciation is one part of an industry development strategy; another part is bounty capitalisation. This involves willingness on the part of a company to capitalise an existing bounty on condition that it invest in new technology. Leading-edge technology for synthetic fibres has the potential to spin off significantly into the wool industry but it will be necessary to persuade the industry of this, disabusing it of the notion that competition from synthetic fibres represents a conspiracy against the wool growers. Enabling DuPont to move into the advanced technology will lead to the efficient production of fibre, and bring added value to the natural fibre.

I use these examples simply to point out that the debate must not be allowed to degenerate into a sterile argument about intervention challenging the free market. The fundamental issue is identifying our opportunities and developing sensible industry development strategies around those opportunities. Science and technology can play a critical role in building those strategies, so that we can really start realising our assets.

Let it not be an abstract debate: we must confront the realities.
It has been remarked that in the last thirty years Australia has become an offshore quarry as well as an offshore farm for the world's industrialised and industrialising nations. Primary exports make up about 70 per cent of our total exports; manufactured imports make up over 80 per cent of total imports. Because primary product prices have decreased while prices of manufactured products have kept pace with inflation, our terms of trade have continued to deteriorate.

What can Australia do to solve this problem? The answer to this question is complex and has been sought by a number of experts, among them Jackson in 19751, Garnaut in 1989, and Pappas Carter Evans and Koop in The Global Challenge. For its part, ASTEC produced its report entitled Science, Technology and Australia's Future in March 1990. ASTEC's contribution focuses on how science and technology can help Australia's economic and industrial development to the year 2000. It examines the following matters:

1. opportunities for industrial and economic growth;
2. the role that science and technology can play in realising those opportunities;
3. how to integrate science and technology into our industrial and economic growth in order to optimise their contribution to that growth.

As with The Global Challenge, ASTEC based its report on an examination of the actual situation in Australia rather than on theoretical models. To achieve this, ASTEC consulted widely and working parties visited over 100 firms, industry associations and other professionals before reaching their conclusions. The opportunities, impediments and needs that are identified are thus based on the views of those in industry who have responsibility for signing the cheques for new projects or for expansion of their companies' operations.

ASTEC's report takes a longer term view of Australia's opportunities for development in the primary, secondary and service sectors. It focuses on industry sectors and subsectors, rather than on individual products or projects. Many of the areas it identifies as strong prospects will have their ups and downs in the short term, but the report argues that their overall economic contribution can be positive and that effective use of science and technology can contribute to long-term success. Because of the report's longer term perspective, there are no specific recommendations; rather, attention is drawn to prospects, impediments and areas within which change is believed to be necessary.

OPPORTUNITIES FOR INDUSTRY

Figure 1 shows the major areas of industrial opportunity that emerged from ASTEC's study. As might be expected, ASTEC found a mixture of areas of comparative advantage for Australia in the resource sector, as well as some exciting prospects for a more diversified economy. There are opportunities to do better some of the things that are already being done and also to do new things well. ASTEC certainly does not see the Australian economy as being static, with prospects only in traditional areas. One of the

key messages is that Australia's performance and competitiveness will depend on the clever use of technology and human skills just as much as on our natural resources.

FIGURE 1
INDUSTRY OPPORTUNITIES FOR AUSTRALIA

- PRIMARY INDUSTRIES
  - meat & livestock
  - horticulture
  - fisheries
  - aluminium
  - base metals
  - mineral sands

- MANUFACTURING
  - food & beverages
  - scientific & medical equipment
  - defence-related

- SERVICES
  - tourism
  - education
  - health care
  - business consulting
  - engineering
  - computing & financial services
  - regional communications

- AND AT THE INTERFACES
  - eg use of information technology

Like Pappas Carter Evans and Koop, ASTEC found good prospects both in further processing of our resources and in what Pappas Carter Evans and Koop calls 'complex-factor industries'. ASTEC agrees with The Global Challenge conclusion that Australia must change and diversify its industry if living standards are to be maintained.

Looking beyond manufacturing, ASTEC identified a number of export prospects among primary and service industries. Some of these, such as trading in education and health care, can add very high value. There are also excellent prospects at the interfaces
between the sectors and between industries. Again, new technologies are a major contributor to these opportunities. Information and communications technologies, in particular, strongly affect all other industries; for example, there are opportunities to use these technologies in the marketing of rural products and in providing market information to producers. Australia has developed remote sensing and image interpretation technologies of value to agriculture, mining and environmental monitoring. Australian banks lead the world in electronic funds transfer and have new products in software and systems to support this sort of customer service.

ASTEC did not try to pick winners, and it does not assume that all the prospects will achieve their apparent potential. As always, there will be complex economic, social and international factors that sort out the winners from the losers.

OPPORTUNITIES FOR SCIENCE AND TECHNOLOGY

The single factor ASTEC focussed on is the role of science and technology in improving the chances of achieving success. Some of the linkages between technology and the opportunities that ASTEC identified are obvious. If we are to be successful in, say, new agricultural products, then obviously we need to be good at biotechnology, plant and animal production, and so on. Similarly, further processing of mineral resources requires skills in metallurgy, pollution control, and large-scale materials handling.

ASTEC found, however, that there are some broader roles for science and technology that can have impacts across a wide range of industries. The report identifies these roles as follows: creating demand shifts; improving productivity; enhancing quality; product differentiation; adding value; and use of environmental technologies.

Demand shifts

Technology can bring about demand shifts by creating more value for consumers. This can be done not only by adding value, but also by using technology to remove any adverse qualities associated with particular products. For instance, energy technologies that help counter Australia's customers' concerns about pollution, the greenhouse effect, or waste products from energy generation would not only be saleable products in themselves, but would also boost Australia's sales of energy resources; our pioneering work in the SYNROC nuclear waste disposal technology is a good example.

Another excellent example of demand-shift innovation is the SIROSPUN process (developed by CSIRO's Division of Wool Technology), which has massively stimulated the demand for fine wool. SIROSPUN fabrics have a characteristic smooth, cool feel that makes them particularly suitable for lightweight wool products - an innovation that could be worth $500 million a year in export income.

Productivity

Among many other factors, technology has a role in maintaining and improving price competitiveness through enhanced productivity. At the same time, the technology-based tools for improving productivity are burgeoning, and the opportunities for their application in all areas of industry appear endless - from biological methods of pest control in primary industry to information and advanced mechanical technologies in transport and storage.

The introduction of robots can lead to improved productivity under favourable conditions. Australia now has about 1000 robots compared with only 122 ten years ago. These installations can also give improved precision and better and more consistent quality
control. Applications are widespread and include telephone assembly (Alcatel-STC), biscuit packaging (Nabisco), sheep shearing (Australian Wool Corporation), nuclear waste handling (ANSTO), a strip rolling mill (BHP at Port Kembla), automatic aluminium extrusion (Comalco), and spot-welding units (Ford).

**Quality**

There are probably no more demanding and rigorous standards of quality than those set by the space industry, both in the hardware that flies on the satellites and in the ground stations that must constantly track and control those satellites. Obviously, deficiencies in quality or errors in controlling satellites can lead to the irreversible loss of a multi-million dollar investment; a good but unfortunate example is the NASA Hubble space telescope.

In this context, it is encouraging to see that Australian industry and technology can compete internationally in achieving these stringent demands on quality. In the first series of AUSSAT satellites, Australian content was only $1 million, for the wiring harnesses built by STC in Australia. Nonetheless, from this modest beginning STC has secured international contracts to build further wiring harnesses for satellites for other nations. Australia has built rapidly on this small start, and AUSSAT has become totally self-sufficient in the processes of procurement, design, specification and tender evaluation for the next generation of satellites. The tender for these satellites requires the successful bidder to spend a specific percentage of the contract value on spacecraft hardware in Australia. More than $32 million is already being spent in Australia for the manufacture of space-qualified hardware that will be on board the next two AUSSAT satellites. This hardware includes electronics, switches, transmitters, receivers and structural components. Again, it can be expected that successful completion of this work will open up further opportunities to do the same for other nations.

In the area of satellite control from ground stations, it is heartening to observe that OTC’s technical and operations proposal for a new INTELSAT tracking control and monitoring ground station for our region was ranked first, above the bid from Japan. This has led to the award of the contract to Australia instead of the existing station being retained in Japan. Japan is now enquiring about ground support from Australia for its coming rocket launches.

These sorts of examples demonstrate that Australia can master the highly advanced and demanding technologies necessary to provide goods of internationally acceptable quality in one of the most rigorous of industries. It is not too much to claim that OTC’s success with ground stations can be related to that agency’s strong and continuing commitment to research and development over the years.

Another striking example of Australian industry using technology to compete on quality comes from the machine tools area. A Victorian firm called Farley Manufacturing Pty Ltd produces custom-built, computer-controlled metal cutting machines based on the firm’s own research and design. These are winning orders in the United Kingdom, Europe, Japan and the United States, against competition from the well established ‘giants’ in the industry. The firm’s growth has been spectacular, and over 60 per cent of turnover comes from export income. Farley has established a niche in a rapidly expanding market by working closely with its customers and adding features to its machines (such as automated set-up and faster cutting), but, above all, as its founder simply puts it, ‘Because our machines are better’.
Product differentiation

There are opportunities to create new markets through product differentiation. This does not necessarily mean new products: it can mean a distinctively Australian characteristic to a product, an improvement in quality that enhances export chances, or even preparing for export a product that we simply would not use in Australia. In clothing, for example, Maggie Shepherd and Ken Done have developed export strengths based on creative and typically Australian designs.

Australia has already achieved some international success in this sort of differentiation, in the area of food processing and production of wine, where products are recognised overseas as being both of high quality and distinctively Australian. Again, ASTEC’s report argues that technology and research have played major roles in achieving this. There are further opportunities to be exploited. For example, ASTEC’s 1988 report, Casting the Net\(^2\), which deals with post-harvest technology in the fishing industry, points out that we have exploited the techniques of exporting live seafood, particularly to Japan, where it is well recognised as a luxury product. Further opportunities exist if we can learn to process such exotic items as beche-de-mer, fish stomach bladders and lips, and shark fins and skin to match the tastes of markets overseas.

Adding value

Adding further value to our traditional exports is, like improving productivity, an area in which the role of technology is bound up with many other factors and considerations. Nonetheless, there are technological opportunities in adding value; they should be exploited where possible if other obstacles can be overcome. Indeed, Australia has been particularly clever at developing processes to refine or improve our natural resources. We have made significant technological advances in mineral processing, including mineral flotation to produce zinc sulphide concentrates at Broken Hill early this century, continuous refining of lead at Port Pirie in the 1930s and, more recently, innovations in copper refining in Townsville. This last development both enhanced the viability of local processing and led to the sale of the technology. In forest products, Australian research led to techniques for making pulp from hardwoods; for example, in 1986-87 Australia exported 5 million tonnes of woodchips worth $400 million, mainly to Japan. However, if these woodchips had been converted to 1.4 million tonnes of pulp, the value added would have been $900 million. Conversion to paper would be worth another 30-40 per cent increase in value. Recently we have seen the development by CSIRO of ‘Scrimber’, a structural timber product made from small trees removed during forest thinning. Scrimber can compete with imported Oregon and with steel or concrete.

The potential rewards of further processing for export are huge. The Global Challenge estimates that they could be over $30 billion per annum if all opportunities were to be taken up. However, that report also reminds us of the regretfully large number of obstacles to be overcome before even a portion of this can be achieved.

Environmental technologies

As noted, environmentally related technologies can help provide a positive shift in the demand for Australian resources. They can also make further processing of our resources in Australia more attractive and help remove objections from the environmental lobby, as

\(^2\) ASTEC 1988, Casting the Net: Post-harvest Technologies and Opportunities in the Fishing Industry, AGPS, Canberra.
well as increasing the value added of our exports. The technologies can be exportable in their own right and provide a source of revenue. For example, researchers from the CSIRO Division of Entomology are planning to release a tiny parasitic wasp at Condobolin, New South Wales, in a bid to head off a devastating pest - the voracious Russian wheat aphid, which has the potential to cause major damage to Australia's $2.5 billion a year wheat industry. If the project is successful, the potential environmental hazards of spraying with chemical pesticides can be avoided.

Australian firms have developed a wide range of technologies to treat waste materials and to clean up environmental problems related to industry. One development alone, a biological process for treating industrial waste by aeration, has been exported widely. More than 200 computer-controlled aeration plants have been installed throughout the world, mostly in Japan and the United States.

CSIRO has successfully developed a process called SIROFLOC to treat sewage and other effluents. Again, this has been exported and applied in the United Kingdom.

Probably the most visible example of Australian success in this area has been Memtec Limited. It has developed a wide range of membrane technologies both to treat waste and to improve industrial processes. This capability has evolved from excellent Australian research and development that has been, and continues to be, undertaken at institutions such as the Centre for Membrane and Separation Technology at the University of New South Wales. Memtec has become involved in treating one of Australia's most visible pollution problems - sewage disposal in Sydney. It is building a $20 million demonstration plant for membrane treatment of sewage for the New South Wales Government, at Cronulla. Success here will not only be a matter of cleaning up a particularly evident local community problem: it is estimated that the worldwide wastewater engineering industry will spend $300 billion over the next five years. Four British cities alone are interested in the technology to be tested at Cronulla; if all their orders were captured, the market would be worth $70-100 million.

The development and application of Australian environmental technologies in areas such as waste management, pollution control, and treatment of sewage offer exciting prospects for earning substantial export income as well as alleviating community concerns.

INTEGRATING SCIENCE AND TECHNOLOGY INTO INDUSTRY

Technology and its imaginative use are but one determinant of economic success. The Global Challenge gives a broader picture of many of the other factors. ASTEC believes, however, that technology has become much more important as a factor than it was in the past. Many of the changes that define the modern world have come about through clever application of new technologies and research. Developments in industry, such as globalisation and the increased flexibility of major firms in the location of their operations, are the result, at least in part, of new transportation and communications technologies. Comparative advantage is yielding to competitive advantage, which has more to do with being clever than with being resource rich.

These trends will not stop; indeed, they will accelerate. ASTEC believes that industries have barely scratched the surface of information and communications technologies, and there are further waves to follow in areas such as biotechnology, genetic engineering, new materials and advanced manufacturing technologies. The successful nations will be those that allow science and technology to be taken up quickly and used to advantage.
The United States Department of Commerce's Secretary for Productivity, Technology and Innovation, Dr Bruce Merrifield, put it this way: 'Any company that is not either developing new technology or adapting advanced technology to their present business has made a decision to be out of business in five to ten years.'

Our competitors have already recognised this. As an example, consider the extraordinary situation that among major Japanese firms investment in R&D is now greater than investment in plant and equipment. Those firms see knowledge itself either as the saleable product of tomorrow's world or as the raw material from which tomorrow's products will be fashioned.

The same conviction is yet to be held widely in Australia. Our performance in business expenditure on R&D is well known to all observers of Australian industry; it is shown in Figure 2. Even if we adjust for Australia's industry structure - that is, allow for our having rather less technology-intensive industry than many other OECD nations - we are still not in good shape by comparison.

The messages for Australia are clear. We are starting from a long way behind. We need to take whatever steps are necessary to encourage industry to innovate, to take up new technology, and to work as hard as it can to gain competitive advantage from research and technological development. The Government's new Cooperative Research Centres Program offers industry an important new opportunity for R&D collaboration. Establishing this sort of environment is dealt with in The Global Challenge.

![Figure 2](image)

**FIGURE 2**
R&D EXPENDITURE: SELECTED NATIONS, 1987
(PERCENTAGE OF GDP)

Source: OECD.
From the science and technology viewpoint, ASTEC certainly agrees with The Global Challenge in its assertion that there must be a third arm to government policy relating to industry. It is not enough simply to encourage competition in industry and to remove the impediments to better performance through microeconomic reform. Government in Australia is too involved in generating and using research and technology simply to be a bystander. It must continue to provide a lead, and take its share of the responsibility for measures that will promote R&D and the production of skills and knowledge. It must also be active in stimulating the demand for innovation in industry.

Harvard Professor Michael Porter's recent analysis, in The Competitive Advantage of Nations, emphasises that trade policy must be linked to science and technology policy, macroeconomic policy, industry policy, regulatory policy and education and training policy - these are, or should be, all aspects of the central strategic imperative of sustainable economic growth.

OVERCOMING MAJOR BARRIERS

ASTEC’s report identifies areas (again, principally linked to science and technology) in which active government involvement is required. As with the general perspective of the report, these areas are broad. They concern international marketing; science, technology and industry potential; human resources; and a change in attitudes.

International marketing

As a nation we have become adept at the international marketing of agricultural products, but we have been less successful at marketing manufactured products and are only just beginning to exploit the export potential of our service sector. ASTEC’s report suggests that, to compete successfully, Australians must expand their outlook beyond their own boundaries. We need to recognise that most of our customers live in the Asian and Pacific regions, and we must become attuned to the sensitivities of those regions. We need to make greater efforts to learn about their languages and cultures, so as to be able to trade more effectively. We need to form scientific, technological and business linkages with companies in these regions. The Global Challenge mentions some of the measures necessary to strengthen those linkages.

We need to encourage the development of better marketing skills and the establishment of specialised marketing firms that can represent Australia and its products in those areas. As a basis for all this, we should encourage the formation of domestic strategic alliances so as to extend the marketing reach of small firms or groups of firms. An emerging emphasis in industry policy is on so-called clusters of firms that collectively provide a competitive advantage for particular industries in particular countries. There are some small but encouraging signs of such cooperative clusters emerging in Australia.

Science, technology and industry potential

While industrial R&D is vital, it must be acknowledged that the successful use and application of technology in industry encompasses broader issues such as the role of training and extension services and the transfer of technology from other industries and from research-based institutions. We need to understand better how industry acquires technology and uses it to advantage, and to recognise the legitimate role of government in assisting and stimulating these processes. Government programs such as the

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150 per cent industrial R&D tax incentive, the Grants for Industrial Research and Development scheme, the National Procurement Development Program, and the National Industry Extension Service all play worthwhile roles but their performance needs to be monitored continually to ensure that their effectiveness continues as circumstances change.

The challenges of production in the late-twentieth century now include finding socially acceptable scientific answers to problems of pollution, degradation of soil and water and, perhaps most important of all, climatic change.

Human resources

In each of the industries discussed in the ASTEC report - indeed, across the economy generally - improvements in productivity and in the development and design of new products will not occur unless skilled people, and the techniques to improve skills, are available. The range of skills required is diverse: managerial, financial, marketing, scientific and technological. The system that generates these skills - predominantly in the public sector - is in urgent need of repair and improvement.

The supply of human resources and skills has been of continuing concern to ASTEC. It produced reports on education and training in 1987, and in 1989 a report entitled The Core Capacity of Australian Science and Technology. That report dealt with the weakened state of Australian science and its inability to meet the demands that will be placed upon it by the sorts of industrial and technological developments discussed in this paper.

It forecast that by the year 2000 there will be a worldwide undersupply of scientific, technological and engineering skills, and that Australia's science and technology capacity will suffer as a result. It called for a range of measures to increase the supply of skills and research training, among them the following:

- increases in the value of Commonwealth postgraduate award stipends;
- research funding agencies to include financial support for PhD students in the programs the agencies fund in universities;
- the offering of research positions in research institutions on a long-term contract basis, with opportunities for promotion and extensions available by open competition;
- the introduction of visiting fellowship schemes to facilitate mobility among research sectors;
- the establishment of academic staffing policies that support a greater variation in the balance of responsibilities of individual staff members among research, scholarship and teaching.

It is pleasing that the Government has recognised the need for a 'clever country' and has substantially increased the resources going to higher education, creating new places and increasing the number and value of postgraduate research awards.

A change in attitudes

The pressing need for attitudinal change in Australia is often the subject of comment. Certain characteristics of Australian business, labour, academic and political culture exacerbate the already formidable task of improving our national industrial performance. The industrially successful countries that we wish to emulate - Japan, West Germany, Sweden and South Korea - are all characterised by a high degree of national coherence and economic citizenship that seems to elude us. A national vision of where we want to be in the twenty-first century, one shared by all sections of the community, is long overdue.

CONCLUSION

In conclusion, two quotations are apposite:

To compete successfully in a world that is becoming more international and more competitive, [Australians] must expand their outlook beyond their own boundaries. They must gain knowledge of other languages, cultures, market customs, tastes, legal systems and regulations; they will need to develop a new set of international sensitivities.

and

Fundamental changes in attitude will be necessary. Just accepting the need for a sense of common purpose - a shared national goal - may require the biggest attitudinal change of all.

These quotations are not from an Australian source; they come from the Massachusetts Institute of Technology's Commission on Industrial Productivity, in its report Towards a New Industrial America. The Commission is made up of some of the Institute's most distinguished leaders, including two economists, one of them a Nobel Prize winner. If the word 'Australians' is inserted in place of the word 'Americans' the message becomes especially appropriate for Australia.

Reports such as ASTEC's and that produced by Pappas Carter Evans and Koop for the Australian Manufacturing Council can provide at least part of the basis of facts and opinions on which genuine shifts in attitudes towards Australian industry development can be achieved.

TECHNOLOGY CHOICES IN AUSTRALIAN INDUSTRY
Mr Peter Laver
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This paper examines the report of Pappas Carter Evans and Koop and the Garnaut report from the viewpoint of an Australian businessman trying to make a living in the current difficult environment. It provides an interpretation of the rather sweeping policy-type statements made in those reports and attempts to give them meaning in the business context.

BHP is in an interesting situation, involved as it is in the gamut of businesses, from its $5 billion a year steel business to what has the potential to become a $5 million a year instruments business, from a business employing about 30 000 people to one employing about seven. Thus BHP is confronted by a great range of possibilities; the issue is how the proposals made in those reports might affect such an organisation in the future.

How a business works

Figure 3 shows a simplified model of how a business works. It does not show the cycle of misery represented in The Global Challenge; rather, it shows a continuous process involving the various steps that must be considered when establishing and operating a business.

Let us begin with funding. The first requirement is capital, in the form of equity or in the form of debt, which may mean borrowing money to start the business. Following this is survival: it is necessary to generate enough cash flow so as to pay the interest to the lenders of the start-up cash. When the profit stage is reached it is time to think about the shareholders, who will be seeking dividends in return for the equity they have injected into the business, and to consider possibilities for growth.

At this stage it becomes necessary to make a decision about the proportion of profits that might be retained for reinvestment in the business and the proportion that might be returned to the shareholders. This decision is the first of the tensions that result from some of the philosophies espoused in the two reports we are considering. It is all very well to talk about joint ventures, strategic alliances, and the like, but such linkages are difficult: each participant can have widely divergent objectives, particularly short-term needs for cash relative to long-term needs for growth, and these objectives can vary over time.

THE ROLE OF TECHNOLOGY

Where does technology come into all this? Figure 4 shows two technology options. In the survival and profit stages, technology is tactical, aimed not at opportunities for growth but at making the existing business work better. Strategic technology becomes more relevant in the growth phase.

Tactical technology

For survival and profit, there are two basic avenues: to increase revenue or to reduce costs. Increasing revenue can include increasing market share and finding new markets. Finding new markets can mean creating new products by using existing capital investment; that is, eliminating the need for incremental capital and increasing capital productivity - getting more from the existing investment. It can also mean obtaining higher prices. Cost
FIGURE 3 CONCEPTUAL DEVELOPMENT OF A BUSINESS

GROWTH

PROFIT

Dividend

SHARE- HOLDERS

Equity

SURVIVAL

Retained earnings

FUNDING

Loan funds

Retained earnings

Dividend

Interest etc

LENDERS

FIGURE 4 CONCEPTUAL DEVELOPMENT OF A BUSINESS: THE ROLE OF TECHNOLOGY

GROWTH

PROFIT

TACTICAL TECHNOLOGY OPTIONS

Dividend

SHARE-HOLDERS

Equity

SURVIVAL

Retained earnings

FUNDING

Strategic technology options

Loan funds

Interest etc

LENDERS
reduction includes increasing labour productivity, decreasing materials consumption, and reducing overheads, purchases of services and other charges.

Technology can have an impact on all these choices. It can increase customer value, for instance, by improving quality - if quality can be improved, the customer can be charged more and revenue will increase.

Technology is not a panacea; it needs to be a component of a broader business plan. In this plan the critical factors in increasing revenue or reducing costs need to be defined, after which it becomes possible to develop a technology plan for the business. An analysis of the contribution of various factors in determining competitiveness might show that the problem has nothing to do with technology; for instance, marketing might be poor. Or perhaps the problem is employee performance: technology will rarely solve an industrial relations problem - in fact, it can work in the opposite direction. Again, perhaps the product is not satisfactory, or delivery performance is below standard. A technology strategy must be based on an understanding of the impediments to a successful operation.

Once the contribution technology can make has been analysed, it is necessary to ask two questions. First, where does technology rate in the order of priority of all those factors - industrial relations, marketing, and so on, to increased revenue or reduced costs and improved margins? At the top, the bottom, or somewhere in between? The second question is to what extent is the technology the source of competitiveness of the business? In other words, is the technology the reason there is a business at all?

Figure 5 provides an indication of the types of business in which BHP is involved. The vertical axis plots the answer to the first question, the extent to which technology contributes to profits; for instance, BHP Iron Ore does not depend on unique technology, with industrial relations, marketing, and so on - having more significant roles. The contribution of technology to profit comes through the application of technology to produce more of the product or to produce it more cheaply.

On the horizontal axis, technology becomes the source of competitiveness in the case of more differentiated products - the 'high tech' products - for which the cost of production becomes less important but the technology embodied in the product or the process becomes the distinctive source of competitiveness.

BHP's commodity-type businesses tend to be on the low end of the horizontal scale; when it comes to more differentiated products (such as high technology coatings on steel or the new instruments company) there is competition from all around the world and it is necessary to go towards the right-hand end of the horizontal axis: if BHP's instruments are made more cheaply it might be possible to sell more of them, so this business rates high on both axes. Basically, however, it is the distinctive technology embodied in the products that creates the competitive edge.

Thus, the location of any business within the axes of Figure 5 must be determined: it influences future technology options. For example, a high score on the horizontal axis means technology cannot be purchased as it is the major source of competitiveness. This means an in-house research laboratory and development of products. A high score on the vertical axis means that the main concern is cost: why design a new electrical shovel to mine iron ore or coal better when the best technology available can be purchased more cheaply? In fact, this can even work in reverse: in-house developed technology may be sub-optimal - not using the best technology means competitors' costs will be lower. For Australia's research performance in many industries, it is this sort of competitiveness that is at issue, rather than the production of high value added goods.
A low score on both axes means that factors such as industrial relations assume much greater importance than technology. To an extent the funding issue for tactical research is relatively simple to manage - if the cost of research and the likely benefits can be quantified it becomes relatively easy to decide whether investment should be made.

**Strategic technology**

Once a business reaches the stage of making profits, the question is what to do with those profits. Some of the spare cash will go back into the existing business, to update plant, and so on, but that is not really expanding the business. One option is to return a dividend to the shareholders. Another is to repay a portion of the debts of the business.

There is a formula that says there is a certain optimum borrowing level for a company, that if a company is underborrowed it is not fully using its resources and that if it is overborrowed it becomes vulnerable. The conventional wisdom for BHP is that 40 to 45 per cent of total funds should be borrowings. If the proportion is greater and an economic downturn occurs the interest cover becomes deficient. If the proportion is less than 40-45 per cent then the company has borrowing capacity that it is not using. So, returning funds to the lenders is usually only an option if borrowings are above the optimum level. Another option is to invest passively: say, in a building society or by buying bits and pieces of other companies. But this is just depositing money somewhere and it is not the business of business. Business is about using money to do things.
There are three viable and competing options. The first is to expand existing businesses - introduce new products, new markets or new capacity, or expand to different locations. The second option is to add value to existing products, both upstream and downstream, and the third is to invest in new businesses, either by developing a new business out of an existing one or by diversifying. The technology impacts for each of these options are different.

Technology has little relevance if cash surpluses are used for returning money to shareholders or lenders. It has some relevance to passive investment: sometimes it may be wise to make a passive investment on the basis of the technology embodied in another company, with an eye for assessing whether that technology might be worth pursuing in the future. However, the technology strategy is only truly relevant to the last three options - expansion, adding value, and investing in new businesses.

**Expanding existing businesses**

Expansion is the easiest option. It is comfortable, people who know the business and the technology are already available, markets are known, and the risk-to-reward ratio is lower.

Expansion means servicing market growth, which is unspectacular in most businesses if it relates only to population or economic growth, or increasing your market share. Production for export is obviously another option for staying in the same business, or investing overseas in similar facilities. The implication is that, because it is the same business, little strategic research is necessary. It is necessary to stay competitive but, providing the cost of production is contained, quality improved, and so on, that is probably all that is necessary as far as a technology strategy is concerned.

This is a preferred option for Australian companies. It is the way that BHP's minerals and petroleum divisions work: BHP Minerals, for example, judges that the way to make more money is to find more minerals, either elsewhere in Australia or elsewhere in the world, and to mine them. In general, this has been a successful strategy. The return on investment is much better than trying to add value to the minerals already mined.

**Backward or forward integration**

The second alternative is adding value, which means forward and backward integration, a company thereby becoming its own customer or its own supplier, or both. It means that margins increase, that there is a secure source of supply or a secure market, and that something is understood of the technologies involved. It also means - and The Global Challenge fails to mention this but it can be very important - that the awkward situation of a company competing with its customers can arise. If, for example, BHP wanted to add value to manganese ore in Australia, expanding massively so as to compete with the Japanese ferro-alloy suppliers, it could find that all the ferro-alloy suppliers in Japan who currently buy their manganese ore from Groote Eylandt would suddenly start buying it from elsewhere because they would see BHP as a competitor rather than as a supplier.

Unfortunately, too, Australia poses numerous environmental constraints on the sorts of businesses at which this country excels: if we export raw wool the scouring problems are transferred elsewhere; if we export coal the coke oven problems are transferred elsewhere. Much of the next stage of processing that is often discussed in reports such as the two under review here runs into similar impediments. Sometimes it is easier to build on an existing industry rather than to try and start a new one. And, as covered in both The Global Challenge and the Garnaut report, other impediments come in the form of transport costs, and so on.
What are the technology implications if adding value is the alternative chosen for growth? Some strategic research is necessary to move into new markets and new product areas. The level of research must increase and the technology input must become more complex. The tendency is to focus more on product research than process research if the move is downstream.

**Investing in new business**

The third option - investing in new business - has two broad approaches. The first of these is what might be called 'the Alan Bond system of doing business': if there is a booming stock market and a booming commodity market this can be a reasonable option, but diversification for its own sake is generally not a good idea. A purchaser needs to be able to add something to an acquired business. It can be in the form of management, supplying a specific input, provision of a market or of some technology ... not just adding money. Successful investors in new businesses tend to be those who have found an underpriced asset or who have capitalised on a change in market or consumer taste; or maybe there has been a change in government policy that warrants exploitation. From a technology viewpoint there is little impact because in all likelihood the technology required will be purchased as part of the business.

A safer and generally far more attractive, if less spectacular entry into new businesses can be made by building on existing strengths. For example, as BHP is in the steel industry it must know something of making dirty water and then cleaning dirty water, so perhaps the water purification industry would be a worthwhile investment. Or because BHP is involved in the mining industry it knows something of maintaining heavy vehicles, so perhaps a heavy vehicle maintenance service would be profitable. This is basically a question of building on existing skills that can be sold back internally while external markets are developed. It is a higher risk strategy than staying in the same business, and it does require a significant technology input because it usually involves new products and new markets. Various options can be followed, including 'start-ups', alliances, joint ventures, venture capital and takeovers.

BHP has recently been involved in a couple of start-ups: the instruments venture has already been mentioned, but there is also an aerospace and electronics venture. BHP Aerospace and Electronics is a small defence-related company begun about eighteen months ago. It is still in a negative cash flow position and is likely to stay that way for some time yet. BHP Instruments also remains in a negative cash flow position - all that has been possible so far is to hire an office, put some people in it, and say 'Go to it!' That is not a very good way to do business, particularly with the high interest rates that prevail in Australia. Something more needs to be done to seed the company. For a large company like BHP, it is probably wiser to avoid starting up too many new businesses, even if they do grow out of existing businesses; takeovers may be preferable, or simply expanding an existing business.

Alliances are much discussed in both the Garnaut and Pappas Carter Evans and Koop reports, but they pose the problem of the mutuality of partner objectives. They are advantageous when they are project based, when there is a particular orientation. The defence industry is a good example: different companies team up for a specific project, they both bring skills, they have a finite agreement, and when the project is completed they go their separate ways. One could call this a 'one-night stand' mentality, as opposed to a 'marriage' mentality. One-night stands are not necessarily the ultimate solution, but at least they are quick and clean and hopefully without ramifications or regrets if something goes wrong.
On the other hand, the long-term joint venture type of option is very prone to gradual divergence of interests. To be successful it must have a very clearly defined mutuality of objectives and a good understanding of the long-term modus operandi of the participants. Failing that, after two or maybe ten years, participants' aspirations begin to drift apart: usually the argument is the short term versus the long term, how much money to put back into the business and how much to take out.

For this reason, BHP is generally wary of joint ventures. If it does become involved it seeks the controlling interest. It is happy to have a 15 per cent Japanese interest in its iron ore business because the Japanese act as selling agents in their country and provide useful commercial information. In turn, the Japanese are content with the arrangement because they have access to BHP's financial information. More and more Australian companies are realising that fifty-fifty joint ventures or multi-company joint ventures are difficult. To be sure, they can be made to work, but they are difficult.

Then there is the venture capital option. BHP has a $50 million venture capital fund. The most successful enterprise of this kind is in the United States, where BHP has a very tight charter, it works through a managed fund, and it has defined four technology areas of interest: waste management, advanced materials, process control, and remote sensing. The deals are not to be found in Australia - there is not the mentality that exists in the United States. The BHP fund has spent about $5 million in Australia, but this is spread over about eighty investments, so the impact is small and very diffuse. By contrast, in the United States BHP has spent two or three times that amount on about thirty investments; some of them are very satisfactory.

Takeovers are the preferred route for a substantial company to expand into a new area. To expand into a new business a company needs to find a technology, an industry, and a target company with which it is comfortable, one with an established cash flow, which can be taken over on a friendly basis. Often, the takeover target is a small company that has run out of borrowing capacity, needs extra funding, and with existing shareholders and staff who are willing either to take a management position or to take their money and try something else.

The only major problem that can result from such a takeover is differences in culture and approach between the small and the large company. For the large company there are positives in terms of its lesser vulnerability to the vagaries of the market, its cash reserves, the negotiating power it has with suppliers, governments, unions, and so on, its ability to cross-subsidise during downturns, its greater borrowing capacity, and its own resources and specialist skills. However, contrary to popular belief, a large company's overheads are usually higher than those of a small company. It has less flexibility and more bureaucracy; it becomes more impersonal and tends to be more conservative.

CONCLUSION

Technology is a tool in all of these activities. We need to understand its role and use it to evaluate our options. Unfortunately, and quite often as far as Australia is concerned, too many of the entrepreneurs are too busy trying to make an honest living to take the time to attend seminars or read reports, or even to worry about what they have spent on research. That goes to the heart of the problems that confront this country.
The Global Challenge joins a growing list of calls for the inclusion of networking on the industry policy agenda. The Australian Chamber of Manufactures, the Metal Trades Industry Association, and the Australian Council of Trade Unions are some of the more prominent organisations publicly advocating the creation and development of industry networks. They are supported by a range of people from government, academic, union and industry circles.

But, despite what appears to be general agreement on the importance of industry networking, there appears to be little agreement about what that networking entails, let alone how it can be translated into public policy. Consequently, this paper has two aims:

1. to clarify the nature of network relations and the importance for the competitiveness of firms;
2. to give some preliminary ideas, based on both Australian and overseas experience, of the role of public policy in facilitating the growth of network relations.

THE IMPORTANCE OF FIRMS' EXTERNAL RELATIONS

There is increasing recognition that a firm's relationships with other firms and related infrastructure shape its operating environment and ultimately its competitiveness. External relations affect the way a firm competes, how it is managed, and its ability to innovate and upgrade its products and processes. External relations are the fabric of networks.

There are a number of reasons why external relations have become an important topic in industrial policy debate, among them the following:

1. the re-emergence of industrial districts;
2. the drift to cooperative business organisation;
3. the work of Michael Porter¹ and the notion of competitive clusters.

Other evidence, such as the source of ideas for innovation, also supports this emphasis on external relations.

The re-emergence of industrial districts

One of the more remarkable developments of the 1970s and 1980s has been the re-emergence of the industrial district as a significant economic and political unit across a wide range of advanced industrial countries. The conspicuous success of districts such as Emilia Romagna in Italy, Baden-Wurttemberg in West Germany, Sakaki in Japan, Jutland and Smaland in Scandinavia, Rhone-Alpes in France and Silicon Valley and Route 128 in the United States, has focussed attention on how inter-firm relationships and cooperative behaviour can enhance the competitiveness of firms and industries.

These districts stand out not only for their economic success, but also for a system of production centred on interdependent networks of flexible and innovative small firms operating in a complex environment of cooperation and competition.

The drift to cooperative business organisation

The re-emergence of the industrial district has both been the product of and been reinforced by wider trends in markets and technologies. Since the early 1970s there has been a discernible shift in demand from standardised products (mass produced on dedicated equipment to capture economies of scale and competition purely on the basis of price) to more customised products (higher value added products embodying higher levels of quality and design with typically shorter product life cycles). At the same time, advances in process technology now favour manufacture of these goods in smaller production units. Small firms are better placed to serve specialised markets and fragmented demand (through flexible niching strategies) or to perform specialised manufacturing services for larger firms that lack the flexibility to innovate and respond to rapid changes in demand.

Large firms have responded to changes in markets and technologies by devolving more of their functions to suppliers and subcontractors and developing closer relationships with selected partners. They are spreading product development costs among their subcontractors and seeking to capture the benefits associated with the flexibility of smaller organisations. Some large firms are beginning to resemble 'systems integrators' - a network hub that concentrates resources on coordinating and stimulating the supplier network, developing proprietary technologies, concept design, marketing and distribution. For example, the motor giant BMW currently contracts out 75 per cent of its components and over 80 per cent of parts purchased involve important collaborative work with a specialist subcontractor. BMW itself provides overall know-how and design services to the production network.

Changes in markets and technologies are producing a double convergence of small and large firms' structures, with inter-firm relationships assuming new importance. As Zeitlin observes,

Small firms ... are building wider forms of common services often inspired by large firm models, while the large firms themselves increasingly seek to recreate among their subsidiaries and subcontractors the collaborative relationships characteristic of the industrial districts ... Either way it requires firms to cooperate with their workforce and suppliers in order to meet the demand of shifting markets through constant innovation in the products and production processes and to share the risks of increasingly complex and uncertain investment projects. And either way, too, geographic proximity facilitates the personal contacts, frequent interactions and short supply lines on which these collaborative relationships depend, encouraging the reconsolidation of the industrial region as an integrated productive system.

Porter and the notion of competitive clusters

Porter sees the competitiveness of a firm or industry as the product of an interactive system. His system has four elements: a nation's position in relation to factors of production; the nature of home market demand; the strength and competitiveness of related and supporting industries; and how companies are created, organised, managed and

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compete against one another. The interaction of points in the system creates pressure and challenges firms to innovate; it also determines firms' ability to respond to these signals. Porter also observes a concentration of related firms and industries in the form of competitive clusters:

Clusters of competitive industries are not scattered helter-skelter throughout the economy but are usually linked together through vertical (buyer-seller) or horizontal (common customers, technology, channels) relationships. Nor are clusters usually scattered physically; they tend to be concentrated geographically. One competitive industry helps create another in a mutually reinforcing process ... Once a cluster forms, the whole group of industries becomes mutually supporting. Benefits flow forward backward and horizontally. 3

Again he states (in relation to the idea of industrial districts),

More significant than mere access to components and machinery ... is the advantage that home based related and supporting industries provide in innovation and upgrading - an advantage based on close working relationships. Suppliers and end-users located near each other can take advantage of short lines of communication, quick and constant flow of information, and an ongoing exchange of ideas and innovations ... Through the conduits of suppliers and customers who have contact with multiple competitors, information flows freely and innovations diffuse rapidly. Interconnections within the cluster, often unanticipated, lead to perceptions of new ways of competing and new opportunities. 4

The source of ideas for innovation

Evidence of the process of innovation also underscores the role of inter-firm relationships. In a recent study the Australian Manufacturing Council examined the source of innovative ideas in three very different manufacturing sectors: metal and architectural fittings, medical and scientific equipment, and softwood sawmilling. Each sector differs in many respects - in the technological trajectory followed, the relative importance of research and development, the predominance of product vis-a-vis process innovation. But they do have one feature in common - most ideas for innovation are taken from external sources (see Figure 6). Customers, suppliers, competitors and, for the medical and scientific equipment sector, the CSIRO and universities are the source of most ideas for firms.

NETWORKING AND INTER-FIRM RELATIONSHIPS

All firms develop external relationships of some kind and some firms undoubtedly do it better than others - networks develop naturally. We distinguish network relationships from the many other forms of inter-firm association by the fact that network relationships assist in developing and augmenting a firm's core competencies and are usually the product of deliberate strategy.

For example, network relationships include instances when firms collectively market their products overseas, when they get together to provide specialised training or other business

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4 ibid., p. 80.
services, when they collect and share strategic information, when small independent firms with complementary skills or expertise are able to collaborate in the design, production and distribution of proprietary products, and when lead firms, through the close relationships they develop with subcontractors, drive new business and management practices down the chain of production. These sorts of relationships require commitment and active planning by participants.

There appear to be two dominant forms of network relationships: production networks and information/service networks.

**Production networks**

Production networks are based on vertical buyer-seller relationships. If an industry carries out a large number of activities (such as research, development, design, production and marketing of goods) different organisations will specialise in subsets of these activities, accumulating idiosyncratic knowledge, experience and skills. The coordination of these activities can bind partners through mutually agreed plans and long-term obligations. For
example, a car assembler such as Ford is the focus of the activities of myriad primary and secondary component suppliers. Ford's role is to design and coordinate a complete production process in which a large number of components come from outside the firm and are assembled into cars. Most elaborately transformed manufactures are produced through some form of collaborative production arrangement involving diverse and specialised firms.

Production networks can comprise relatively small numbers of firms, independent of lead firm relationships. Wherever firms can cooperate and contribute a specialisation or expertise in the manufacture, design or marketing of an end product, production networks can form. They have a number of identifying characteristics:

- production is the basis for the relationship;
- they involve multiple firms;
- they involve complex manufactures;
- they involve quite different and specialised firms operating in a collaborative chain arrangement;
- the firms involved are not usually competitors;
- the networks tend to be geographically concentrated, to facilitate close working relationships and short communication and supply lines;
- often, although not always, they are driven by a core or lead firm (a system integrator) but contain mostly small and medium sized firms.

Information/service networks

Information/service networks tend to be based on horizontal relationships rather than on the vertical relationships that characterise production networks. They involve groups of firms that have in common certain technologies, related products, markets or customers. They typically attract groups of small firms that are relatively independent of one another but are seeking to achieve the sort of critical mass that is usually the domain of larger firms. They target areas in which size is important; for example in export promotion, the provision of specialised training, research and product development, and strategic information gathering.

Service/information networks also share a number of characteristics:

- scale in the provision of services or information is the basis for cooperation;
- they involve multiple firms;
- they involve like or similar firms related through some horizontal association for example, common technology, markets, customers);
- they tend to be geographically based, although this is not as critical as it is with production networks;
- they involve small and medium sized firms - participants are typically price takers in their markets and their individual actions will not affect the market.
Australian Experience in Establishing Network Relations

There is a great deal of literature describing the experience of regions such as Emilia Romagna and Baden-Wurttemberg in building network relations. However, building networks is not merely a continental phenomenon. There are in Australia examples of both production and service networks which confirm that network relations are possible. Companies such as Black and Decker, Country Road and AMECON, in addition to the automotive assemblers, are examples of production networks. Black and Decker, for instance, provides quality product engineering, factor flow and layout and design expertise to Chief Kitchenware, who are contract manufacturers to them of kitchen products. Similarly, the automotive assemblers now work closely with their suppliers on quality programs and the introduction of new production techniques. These relationships go beyond traditional subcontracting and involve the transfer of expertise.

Established service networks also exist in Australia. The Plywood Association of Australia, which draws together seventeen plywood mills, has evolved since 1965 to become a vehicle for the delivery of specialised business functions and services to companies in activities that the companies themselves could not effectively provide or gain access to. In July 1989 the Australian Furniture Research and Development Institute was established to provide specialised engineering and scientific services to the furniture industry; it now has over fifty furniture manufacturers as members. The Australian Electronics Development Centre provides training for the electronics industry; all major companies in the industry participate.

Nevertheless there remains considerable scope to further develop network relations in Australia, to improve the competitiveness of manufacturing industry. Development thus far has tended to be ad hoc and is not supported in a systematic way by public policy, as is the case in other countries.

Reasons for Supporting Network Development

If successfully implemented, networking offers a range of benefits for firms, among them the following:

- reduced costs resulting from economies of scale in production and in the provision of services and functions;
- scope for increased specialisation and flexibility in production;
- opportunities for risk-sharing in export marketing and research and development;
- speedier access to information, new ideas, production capabilities and technologies.

For these reasons, governments in Denmark, the United States, Germany and Italy have supported networking initiatives, most of them at the state or regional level. Although circumstances obviously differ in each case, two common views underpin the desirability of the networking initiatives as an instrument of public policy for industry development.

First, in order to be successful, networks must be industry driven and provide services that meet the real needs of firms. As a consequence, most network programs require matching commitments or fees for service from firms that demonstrate industry commitment. This also means that networking is a relatively low cost policy option.
Second, networks recognise that firms can learn best from other firms, through the transfer of expertise or competitive peer emulation. Networks reinforce these relationships, accelerate the learning capacity of firms, and foster innovative behaviour. At the same time, network initiatives influence groups of firms and provide the means to affect more firms more rapidly.

A sceptic may ask, 'If the benefits are so apparent and substantial, why does networking not occur to a greater extent, or why, indeed, is it necessary for public policy to intervene?'

The first point to make is that networks certainly occur 'naturally' (that is, in the absence of public policy intervention) and the second is that public policy initiatives should be catalytic in nature. But in many instances firms will be reluctant to enter network relations. There are a number of reasons for this. Many firms, or more particularly their owners and managers, will have negative attitudes towards cooperative relations with other firms. They may also lack the ability to network even if the benefits are clear. The central obstacle is that firms will lack credible information on which to assess whether it is in their interests to pursue networking.

Factors influencing network development

Certain factors assist in the formation of network relations, among them a strong regional industrial identity - a concentration of specialist firms, or like or related firms - and the existence of already strong external relationships between, say, lead firms and suppliers or between firms and their industry association or related institutions.

However, the 'brokerage' role is critical in creating and developing network relations. Brokers are individuals, agencies, or institutions that are close enough to firms to provide them with the information on the basis of which the firms can decide whether to enter or build network relations. Brokers will sometimes identify opportunities for cooperation or assist the firms to do it themselves. They will encourage or cajole the firms into participating. The brokerage role requires a high level of communication and negotiation skills, but the most important requirement is credibility with the firms concerned.

Most networking programs recognise the importance of the factors influencing network development. In general, successful policy intervention has three characteristics:

- development of broking capacities;
- use of catalytic actions;
- a focus on the real needs of firms.

One element of the Danish networking program, for example, is training to develop brokerage skills. In Pennsylvania, the state government used the 'carrot' of matching finance to encourage industry associations to play a more explicit brokerage and industry development role. And in Emilia Romagna, the service networks operate on a fee-for-service basis and must aim to become self funding. In all instances, the firms themselves define the needs to be met by the network.

DEVELOPING NETWORKS IN AUSTRALIA

The experience of network development in Australia and overseas suggests that in addition to restricting public policy intervention to a catalytic role, there are a number of key considerations in encouraging network behaviour.
The first is to look carefully at developing brokerage capacity, especially by building on existing relations that firms have with lead firms, sector based industry associations, and service or training centres. These agencies may already be playing a brokerage role that can be built on or extended. It is essential to deal with institutions and individuals that have established credibility with firms.

A second and related consideration is that embryonic clusters at regional concentrations of industry - where there are large numbers of like and related firms and where geographic proximity give a regional identity and facilitates the exchange of information - are probably the most fertile grounds for initiating networking activity.

Third, networks must be firm driven. They must meet the needs of the firms, as the firms see their needs. This will often result in more modest activities than some may think necessary. However, once the practice of cooperation is established new ideas and proposals can be undertaken and the networks can grow into providing more sophisticated activities. (This is not to say, though, that if there are competing claims for public support for networking proposals the sophistication of the networking activity - as long as there is industry commitment to it - should be disregarded in assessing proposals.)

Networking raises a further range of policy questions that also warrant discussion:

- how to promote cooperative strategies to firms;
- how to mobilise the networks of industry groups;
- how to encourage lead firms to strengthen their network relations with suppliers and subcontractors;
- where to find and develop network brokers;
- how to harness existing industry programs to support networking.

The Australian Manufacturing Council will be continuing its work on networking and seeking, along with many other organisations, to answer these questions. In doing so, it will help to improve the competitiveness of Australia's manufacturing industry.5

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5 This paper is based on work done at the Australian Manufacturing Council Secretariat by Ian Cox and Anand Kulkarni.
THE NEED FOR A GREATER NUMBER OF STRONG EXPORT FIRMS IN HIGHER VALUE ADDED GOODS

Mr Ralph Evans
Partner, Pappas Carter Evans and Koop

Although, in preparing The Global Challenge, Pappas Carter Evans and Koop worked independently of ASTEC, it came to broadly consistent conclusions. There is also some piquancy in the fact that this seminar is taking place concurrently with the visit to Australia of the Prime Minister of Malta because Malta is one of only two countries that have implemented 'the level playing field' concept advocated by so many people in government. (The other 'country' is Hong Kong.)

The changing mix of world trade

Let us begin with a phenomenon that causes Pappas Carter Evans and Koop great concern, particularly when people advocate the level playing field concept. Figure 7 shows the mix of world merchandise trade in 1963 and 1987. Within this trade it is consumer goods and complex manufactures that are growing fast, not primary products. Some variation occurs as a result of price changes, especially in oil (the largest primary product), but the trend is unmistakable. World trade in services is also growing quickly, but less so than that in complex manufactures.

![Figure 7: Mix of World Merchandise Trade (% By Value)](image)

If Australia falls back on its most basic comparative advantage - primary production - the implication is that we will specialise even more in a relatively slowly growing part of world trade. We want, however, to avail ourselves of complex manufactures (such as fax...
machines) and use them in our industries so as to remain a modern country with a high living standard. The rate of growth of demand for these products is much greater than that for raw materials, here and elsewhere. The long-term question is whether we will be able to increase our raw materials exports rapidly enough to pay for expansion in the largely imported complex-factor goods that we need. Pappas Carter Evans and Koop seriously doubts this, and it doubts that relying on exchange rate adjustments will deliver the high living standard and modern economy we want. This situation has been described by some as a 'terms of trade' problem. But the concern is not so much relative prices as relative volumes of trade. Real prices of high value added manufactures keep falling, but our rate of consumption of them grows faster than the fall in prices.

Figure 8 shows the composition of Australia’s merchandise exports. The statistics show that roughly half of our exports are manufactures, but a closer look reveals that most of these are little-transformed resource products such as alumina, gold, raw sugar or carcase meat. In 1987 Australia exported only $4.5 billion of ‘elaborately transformed manufactures’, which roughly corresponds to final products but also includes such items as scrap metal made from demolished cars and trains. Of this, $1.3 billion went to New Zealand and Papua New Guinea: there is nothing wrong with this, except that it left only $3.2 billion for the major markets of the world - a relatively paltry amount. It would not be exaggerating to say that in higher value added goods Australian manufacturing has made a negligible impact on world markets.

One would like to be able to say that we are doing well in Asian markets. Many smaller economies have hitched a ride on larger or faster growing neighbours - Korea on Japan, Canada on the United States, and so on - and Australia is located fairly close to Asia, which has been growing much faster than the rest of the world. Regrettably, though, the data show that we are doing poorly in Asia (see Figure 9).
In the period 1980-87, Australia's share of the total imports of Japan, China, South Korea, Taiwan, Hong Kong and the ASEAN nations fell from 6.2 per cent to 3.5 per cent. This is a big drop; if it were the performance of a corporation it would be cause for alarm. It may represent growth in absolute volumes, but Australia has not kept pace with Asian growth and has lost share noticeably. Moreover, this has happened almost right across the board, including in areas such as foods, where we should be doing well. The only exception is in energy, where our steam coal exporters have benefitted from (among other factors) Japan's wise policy to diversify its energy sources.

The net result for Australia is well illustrated by Figure 10 from the Hughes report. As Professor Hughes said, Australia is the only developed country for which exports have not increased as a proportion of GDP during the last thirty years. The lines ascending to the right in Figure 10 show the integration that has been taking place. This corresponds to the growth of trade in complex manufactures and consumer products shown in Figure 7 and to the growth of intra-industry trade. Germany, for example, is a large exporter of cars but also a large importer. Its car firms have taken certain specialised positions in the market while it imports cars from differently positioned firms in Japan and other countries. So it is with countless other manufactured products. The trouble is, Australia has been sitting out this global shift towards greater international integration of manufacturing industry.

The strain Australia faces can be seen from Figure 11, which shows the projected trade balance to 1996-97 for information industry products, including telecommunications equipment and computer hardware. In 1988-89 our trade deficit in this sector was $4.4 billion. If all the objectives of the Department of Industry, Technology and Commerce's Information Industries Strategy are achieved, we will have a deficit of $6.2 billion (in constant dollars) by 1996-97. If the objectives are not achieved, the deficit
**FIGURE 10**

EXPORT ORIENTATION - SELECTED COUNTRIES  
(1958 to 1987)

*Excludes exports among member countries of the EC*

Source: Centre for International Economics, "What's wrong with Australia's export performance?", Canberra, 1999 (cited in Hughes Report)

**FIGURE 11**

PROJECTED TRADE BALANCE - INFORMATION INDUSTRIES  
(Assuming IIS Targets Are Met)

Source: ABS; PCEK/Telesis analysis
could be as great as $10 billion. The question is whether we will be able to export enough wool and coal to afford the imports; the view of Pappas Carter Evans and Koop is that pursuit of the strategy is well worthwhile as a way of limiting the strain and extending the range of high value added jobs in Australia, provided the strategy continues to focus on those business activities that can be located here without great cost penalty.

High growth Industries

The Partnerships for Development and Telecom International Development arrangements that make up the Information Industries Strategy have been an important influence in developing the high-growth sector of industries in Australia. Figure 12 shows this development in an international context for the period 1980-87. It shows the following:

1. The United States had the largest such sector in relation to its GDP, and one that expanded and became still more productive but declined in its export-import ratio as Japanese and other Asian imports expanded.

2. Japan's sector was a stellar performer, expanding, increasing productivity and attaining a very high export-import ratio.

3. Canada's sector is larger and more productive than Australia's and has a better trade performance, but it did not significantly shift position; Sweden's sector expanded dramatically.

4. Australia's sector grew and improved its productivity and trade performance, but from a very weak base.

FIGURE 12
HIGH GROWTH COMPLEX FACTOR INDUSTRIES 1980/87
(1987 $A At Purchasing Power Parity)

Note: Circle size is proportional to contribution to GDP
Source: PCEK/Telesis analysis
Lack of strong export firms

Pappas Carter Evans and Koop's research led it to characterise firms as strategic exporters if export business is central to their business or opportunistic exporters if they tend to be less committed or in and out of exporting (see Table 1). Australia has far too few of the former and too many of the latter. Doing something about the lack of strong export firms has been the major aim lacking in the industry policy agenda. R&D, in which ASTEC has a strong interest, must play an important role in developing a greater number of strong firms. Moreover, Pappas Carter Evans and Koop fears that if protection is reduced without attention to creating a greater number of strong internationally capable firms (and vigorous microeconomic reform), the level playing field may be left with no Australian players on it.

<table>
<thead>
<tr>
<th>THE STRATEGIC EXPORTER</th>
<th>THE OPPORTUNISTIC EXPORTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Makes exports a major focus of attention</td>
<td>- Exports are marginal</td>
</tr>
<tr>
<td>- Factors exports into capacity expansion</td>
<td>- Builds capacity for domestic market</td>
</tr>
<tr>
<td>- Develops an export market for the long-term</td>
<td>- In exports one year - not the next</td>
</tr>
<tr>
<td>- Invests in foreign marketing offices and distribution</td>
<td>- Does not invest in market development or distribution - uses middle men</td>
</tr>
<tr>
<td>- Does market research and intelligence gathering</td>
<td>- Has only vague notion of customer requirements</td>
</tr>
<tr>
<td>- Modifies the product to suit foreign tastes</td>
<td>- Sells the domestic product &quot;as is&quot; to foreign customers</td>
</tr>
</tbody>
</table>

Source: PCEK/Telesis

Figure 13 shows that Australian exports of complex-factor goods are small in relation to its GDP, which is consistent with the small amounts of exports of elaborately transformed manufactures shown in Figure 8. The shaded areas in Figure 13 show something else: that other countries have far higher proportions in relation to their GDPs of complex-factor exports handled by large export firms (which Pappas Carter Evans and Koop defined as those with exports worth more than US$500 million per annum). In fact, Australia has only one such firm - BHP Steel International. Korea and Japan have based their successful development strategies of the last thirty to forty years on large indigenous firms. An easier comparison might be with Britain, the United States and Canada, countries with cultures more akin to that of Australia, but they too have far higher ratios than Australia. Canada has thirty times more complex-factor exports from large firms in relation to its GDP than we do. This can be explained to a large extent by our small domestic economy, our isolation, and the fact that we have no large neighbouring economies where export firms can earn their wings. A Canadian colleague, David Pecaut, who worked on the Pappas Carter Evans and Koop project, remarked that Australia is very similar to Canada, except that it does not have Northern Telecom.
The list of complex factor firms (see Table 2) starts with BHP Steel International, now crossing the hurdle of $1 billion of exports. It then includes a number of firms such as General Motors Holden, IBM, Kodak and Hawker de Havilland that are parts of multinationals and whose exports are a response to government intervention programs. Faulding is the first indigenous firm in the high growth industries, with pharmaceutical exports of $120 million. A wonderful firm - would that there were many more like it! The list falls away rapidly, so that by number 25 exports are below $30 million, a very small sum by international standards.

### Table 2

**Australia's Top Complex Factor Manufacturing Exporters**

<table>
<thead>
<tr>
<th>COMPANIES</th>
<th>EXPORTS ($m, 1986)</th>
<th>PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHP Steel International</td>
<td>900</td>
<td>Steel sheet, rod &amp; bar, coated steel</td>
</tr>
<tr>
<td>GM Holden</td>
<td>240</td>
<td>Car engines and parts</td>
</tr>
<tr>
<td>IBM</td>
<td>180</td>
<td>Computer hardware and software</td>
</tr>
<tr>
<td>Kodak</td>
<td>177</td>
<td>Photographic film and paper</td>
</tr>
<tr>
<td>Hawker de Havilland</td>
<td>125</td>
<td>Aircraft sub-assemblies</td>
</tr>
<tr>
<td>F H Faulding</td>
<td>120</td>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td>Kraft</td>
<td>110</td>
<td>Foods and food service products</td>
</tr>
<tr>
<td>ICI</td>
<td>100</td>
<td>Chemicals and plastics</td>
</tr>
<tr>
<td>Nucleus</td>
<td>100</td>
<td>Medical equipment</td>
</tr>
<tr>
<td>Patersville Sleigh*</td>
<td>105</td>
<td>Icecream, pastries, frozen foods</td>
</tr>
<tr>
<td>Chemplex</td>
<td>65</td>
<td>Styrene, Phenol</td>
</tr>
<tr>
<td>Ford Motor Co</td>
<td>59</td>
<td>Cars and parts</td>
</tr>
<tr>
<td>Aerospace Technologies of Australia</td>
<td>57</td>
<td>Aircraft sub-assemblies</td>
</tr>
<tr>
<td>ANI</td>
<td>56</td>
<td>Specialty castings, machinery</td>
</tr>
<tr>
<td>Varian Techntron</td>
<td>54</td>
<td>Spectrophotometers</td>
</tr>
<tr>
<td>Burns Philp</td>
<td>50</td>
<td>Yeast, food ingredients</td>
</tr>
<tr>
<td>AMI Toyota</td>
<td>48</td>
<td>Cars and parts</td>
</tr>
<tr>
<td>United Milk of Tasmania*</td>
<td>42</td>
<td>Cheese, protein products</td>
</tr>
<tr>
<td>Tubemakers</td>
<td>31</td>
<td>Steel pipe, tube</td>
</tr>
<tr>
<td>DPH Industries</td>
<td>30</td>
<td>Aluminium alloy wheels</td>
</tr>
<tr>
<td>BTR Nylex</td>
<td>30</td>
<td>Polymer products, melted fabrics</td>
</tr>
<tr>
<td>Latam</td>
<td>28</td>
<td>Data acquisition equipment, spectrometers</td>
</tr>
<tr>
<td>Containers</td>
<td>27</td>
<td>Packaging</td>
</tr>
</tbody>
</table>

* Processed foods are often considered as a resource-based industry, but most firms here are using low cost resource positions to develop competitive advantages in complex factor segments.

Source: Australian Business - Top 500 Exporters; PCEK/Telestis Interviews
Australia does, however, have a good number of large and strong manufacturing firms - Pappas Carter Evans and Koop found twenty with sales of $1 billion plus (see Figure 14). Most of these firms export very little, even though a good many have replicated the strong positions they hold in Australia in generally non-traded industries such as bricks and beer by acquiring like businesses overseas, mainly in the United Kingdom and the United States. This is not a criticism of these firms - in fact, it is unsure whether they make a positive or negative contribution to the economy at this stage. They do not contribute to the trade balance, but they do represent a major national management resource and could contribute to the trade balance if conditions were more favourable. They and three transport ‘multidomestics’ (Mayne Nickless, Brambles and TNT) show that Australian management is quite capable of competing internationally.

Positive measures to develop a greater number of strong export firms

Pappas Carter Evans and Koop devoted much energy to probing the reasons why Australian firms have not developed their export businesses further. One major cause is obviously that protection makes the home market more attractive than export markets in terms of price and competitive conditions. Another is that Australia lacks patient capital to spend on penetrating export markets, which means low cost capital.

The wine industry provides a good example - see Figure 15. In 1986 Japan widened access to its market, and imports have been growing at a rate of more than 50 per cent per annum. (Obviously, this will eventually level off.) The increased access provides a golden opportunity to build brand positions - something Australia too often lacks. Our wineries are proud of their increased shipments but actually they have only maintained their share of a growing market. The Californian industry (which the Japanese view as very similar to ours) has gone much further, sharply increasing its share of the market. It did this with a United States federal subsidy, a coordinated approach through the California Wine Institute and some Japanese investment back into California (which is beginning to happen in Australia, too).

In order to encourage more Australian firms to act in this positive fashion, one of the measures Pappas Carter Evans and Koop proposes is ‘risk-sharing support’. This is based on the very successful Swedish industrifonden and on an Israeli-United States scheme and a Japanese one now being phased out as no longer required. Funded from within the present export support budget of just under $200 million, it would advance money to competent firms with sound plans for medium-term efforts to enter complex export markets - repayable with interest or a profit share on predefined success, written off otherwise. Pappas Carter Evans and Koop believes this would be much better than the present Export Market Development Grants scheme, which funds activities rather than programs and does not select on the basis of firm or project quality.

Pappas Carter Evans and Koop also proposes the following:

- reinstating R&D tax support to the effective levels of the 150 per cent deductibility scheme before dividend imputation, and cautiously increasing non-tax R&D support as commercial conversion and collaboration between research bodies and industry are seen to increase - many of the successful Australian exporters Pappas Carter Evans and Koop interviewed attributed their success to technical innovation;

- maintaining venture capital funding at the modest levels reached under the Management Investment Companies Program, and assisting the maturing of the venture capital market (for example, with a shift from tax avoiding private money
FIGURE 14
INTERNATIONAL EXPOSURE OF AUSTRALIA'S LARGE LOCALLY-BASED MANUFACTURERS*

Note: Circle size represents 88/89 sales
* (Sales > $1b to 03/89)
** Building Products division only
Source: PCEK analysis based on annual reports and interviews

FIGURE 15
STILL WINE IMPORTS TO JAPAN
(Million Cases, In Containers < 150l)

* The scandal affected Australian product because of confusion over country names
Source: Importer interviews; Japanese statistics
to institutional money) - the Australian Industry Development Corporation and firms such as BHP have valuable roles to play here;

cautiously expanding strategic procurement to help create internationally viable businesses - the $30 billion of government purchasing must offer greater opportunities than at present, although strict conditions must apply;

Firms of global scale

We must pay special attention to those industries in which economies of scale in R&D, production or distribution have led to the dominance of a handful of firms (see Figure 16). For example, Boeing's new 7X7 has a development budget of US$4 billion. Boeing will have to sell more than 1000 of the aircraft to break even, so it is easy to see the source of the concentration of firms.

![Figure 16: The World's Top 8 Producers - Global Scale Industries](image)

Australia is not the natural home to a major firm in the industries shown in Figure 16, but businesses here can play specialist or supporting roles. These major firms are only likely to be here as a result of intervention. Such intervention must be selective. Pappas Carter Evans and Koop suggests that priorities be set on the basis of three factors:

impact on the trade balance (note the case of the information industries in Figure 11);

'externalities' generated through linkages to other industries;

the cost of the intervention.
The car industry is the one that has major linkages to other industries (see Figure 17). It is the major ‘original equipment manufacture’ (OEM) network in Australia - there are many such networks in more industrialised countries. As such, it is a major force for modernisation of industry quality and service standards; for example, in steel. It warrants top priority. Australia is not getting a good enough deal from the car industry now, but could get a better one with a policy akin to the one put forward in The Global Challenge.

**FIGURE 17** INPUT LINKAGES TO THE AUTOMOTIVE INDUSTRY

![Diagram of input linkages to the automotive industry](image)

Other priority industries are information equipment, then aerospace and pharmaceuticals. (Others such as consumer electronics should be left alone - even the French are having difficulty staying in this industry.) The partnership principle should be maintained and strengthened in these industries. The companies interviewed by Pappas Carter Evans and Koop at their overseas headquarters understand it, but it must be administered consistently.

**Overall program**

The strengthening of Australian-based export firms should be part of a comprehensive program of linked initiatives. The other components should be as follows (see Figure 18):

1. vigorous reforms of the home economy to rid us of impediments to development, especially in environmental assessment, transport, the waterfront, and energy pricing;
2. continued phasing-down of protection such as has been occurring for twenty years (Figure 19);
FIGURE 18
LINKING INITIATIVES TO STRENGTHEN EXPORT-BASED FIRMS

Increase Exposure to International Competition

Reduce Impediments to Industrial Development

Use Positive Measures to Build More Strong Export Firms

FIGURE 19
EFFECTIVE RATES OF ASSISTANCE* (%)

* ERA is defined as assisted less unassisted value added as a percentage of unassisted value added.

Source: BIE
protection of the textiles, clothing and footwear industries should be brought into line with other industries after their plan is completed in 1995, and the car industry should have some, but less, protection under a new long-term car plan.

Vision

Finally, a vision for 2000. Pappas Carter Evans and Koop believe it is important to protect vision, although there are those who dispute this. The 'visions' of the Japanese Ministry of International Trade and Industry (MITI) helped many industries prepare to adjust for the rising yen that would result from the likely success of the automotive and consumer electronics industries, and they did so very well. The Pappas Carter Evans and Koop vision (Figure 20) shows the following:

- resource-based manufacturing increasing substantially in absolute size and as a proportion of GDP - it is to be hoped that a good part of this expansion will be in differentiated goods, such as specialty foods and ingredients and coated and painted steels, which depend on the attributes of strong firms, while the rest will be in higher value commodities such as aluminium instead of alumina;

- mature complex-factor manufacturing remaining perhaps similar in size to now, but smaller in relation to GDP, with a great deal of mix change occurring - some firms will rise to the challenge and become globally competitive, while many others will not and will disappear;

- high growth complex-factor industries expanding substantially under the effects of partnerships and indigenous growth, while losses to emigration continue to occur - the sector will continue to be small in relation to its global industry or GDP, and the export-import ratio will remain low;

![FIGURE 20](image_url)

AUSTRALIA
(1987 $A; Circle Size Proportional To Contribution To GDP)

Source: PCEK/Telesis analysis
low wage industries contracting sharply as protection is reduced in textiles, clothing and footwear (and also auto parts), while some parts of this sector will restructure into the complex-factor group through quality improvement, short-run-length operations bringing them closer to the customer, or mechanisation.

Accompanying this will be a shift towards much greater internationalism in all parts of industry and related areas of the community. Performance benchmarks that are relevant will more often be foreign ones than ones from neighbours down the road. To follow Porter's expansion, Australian industry will have to be constantly renewing its sources of competitive advantage.3


3 The illustrations in this section are copied directly from The Global Challenge.
APPENDIX I

EXECUTIVE SUMMARY FROM SCIENCE, TECHNOLOGY AND AUSTRALIA'S FUTURE
This report identifies ways in which science and technology may be used strategically to improve the growth prospects and sustainability of Australia's production of traded goods and services. Significant opportunities for improving Australia's export position exist in the following sectors:

- the primary sector - meat and livestock, horticulture, fisheries, aluminium, base metals and mineral sands;
- manufacturing - food and beverage processing, scientific and medical equipment, defence-related products;
- services - tourism, education and high quality health care, business consulting, engineering, computing and financial services, regional communications.

The report also identifies ways in which science and technology may be used 'across the board' to improve competitiveness:

- by bringing about demand shifts through creating more value for consumers;
- by maintaining and improving price competitiveness through enhanced productivity;
- by creating new markets through product differentiation;
- by improving market position through adding more value before export (for example, through further processing);
- by safeguarding the natural environment through sustainable development.

ISSUES REQUIRING FURTHER ATTENTION

Despite demonstrable opportunities, Australia faces continuing difficulties in using and developing its science and technology to the greatest commercial effect. The report identifies four key issues that must be addressed: international marketing; science, technology and industry potential; human resources; and a change in attitudes.

International marketing

As a nation we have become adept at the international marketing of agricultural products, but we have been less successful at marketing manufactured products and are only just beginning to exploit the export potential of our service sector. The report suggests the following improvements to our marketing efforts:

- recognition that most of our customers live in the Asian and Pacific regions;
- more concerted efforts to learn about countries in these regions, including their languages and cultures, so as to trade more effectively with them;
- formation of scientific, technological and business linkages with companies in these regions;
- encouraging the development of marketing skills and the establishment of specialised marketing firms;
encouraging the formation of domestic strategic alliances so as to extend the marketing reach of small firms.

Science, technology and industry potential

Although industrial research is vital, it must be acknowledged that the successful use and application of technology in industry encompasses broader issues such as the role of training and extension services and the transfer of technology from other industries and from research-based institutions. The challenges of production in the late-twentieth century must, in addition, rest on finding social and scientific technologies that provide some answers to the problems of pollution, the degradation of soil and water and, perhaps most important of all, climatic change.

Human resources

In each of the industries discussed in this report - indeed, across the economy generally - improvements in productivity and in the development and design of new products will not occur unless skilled people, and the techniques to improve skills, are available. A diverse range of skills is required: managerial, financial, marketing, scientific and technological. The system that generates these skills - predominantly in the public sector - is in urgent need of repair and improvement.

A change in attitudes

The need for stronger links between public research institutions and the private sector has been stressed by ASTEC, and by others. Although a greater degree of integration than was previously the case has now been achieved, it should be acknowledged that there is still considerable ground to be made up in this area, especially if Australia wishes to emulate in this respect industrially successful countries such as Japan, West Germany, Sweden and South Korea.
APPENDIX II

LETTER OF TRANSMITTAL FROM THE GLOBAL CHALLENGE
Dear Mr Dix

With this letter, we submit the final report of the Pappas Carter Evans and Koop / Telesis study for the Australian Manufacturing Council, entitled The Global Challenge - Australian Manufacturing in the 1990s. This letter summarises the findings of the report.

It is important to recognise that, notwithstanding the problems it faces, Australian manufacturing has entered the 1990s stronger than it was a decade ago. Productivity and employment have grown, and exports have increased, while protection has been reduced. Attitudes are changing, and there is more widespread understanding of the need for international competitiveness.

However, these gains must not obscure the fact that deep-seated problems remain. Competitor countries have continued to move ahead, and the indications are that our relative competitive position has improved little, if at all. Our deficit in ETMs (elaborately transformed manufactures) is enormous and looks likely to become still larger. And we are losing share in the fast-growing Asian markets, even in basics such as foods, where we might expect to be doing well.

Two questions go to the core of the subject addressed in this report (the first of which extends well beyond the specific brief we set out to address):

1. Why should Australia worry about manufacturing at all? If manufacturing cannot survive here against international competition, will it not be possible to rely on exports of materials, where we have undoubted advantage, and on services such as tourism and education, which are now growing rapidly?

2. Does the current policy agenda of lower protection and micro-economic reform provide us with sufficient means to meet the challenges of global competition?

We respond to the first question by saying that manufacturing does indeed matter to Australia. While further processing of resource-based products is clearly our major opportunity, we definitely need a sector that produces ETMs, and one that, while it might be smaller than the present sector, is much more integrated into the world economy. No modern country of significant size has maintained a vital economy without a strong industrial base that includes at least some tradeable ETM industries.
Moreover, raw and semi-processed materials represent a declining share of world trade, while ETMs account for a growing share. Without some strength of our own in ETMs, we may not be able to earn enough in the long term from exports of materials to afford the growing ETM imports that we will need. As for services, tourism can provide an important supplement to our exports. However it involves too high a proportion of low value-added jobs to form the heart of the wealthy economy for which we aim, while competitive exports of higher value-added services like education and business services can only expand if we have a comparatively strong and diverse home economy.

In responding to the second question, we must state clearly that we support the consensus agenda of lower protection and micro-economic reform. However, we part company with those who take an ideologically pure line and who dismiss the successful pragmatism of countries such as Japan, Singapore, France and Sweden. Our analysis of the performance of Australian manufacturing, and particularly of firms in tradeable goods industries, repeatedly highlights a series of problems that signal that in its pure form the current agenda is not enough. These problems include:

- The structural disadvantages of small size, remoteness, a commodity-driven currency and inward-looking and often subscale industry built in the protectionist era. Our market is often too small to support world-competitive scale, let alone vigorous rivalry among several firms of world scale (as is the case, for example, in the Japanese car industry). Nor do neighbouring countries provide ready grounds for early expansion, as do those of (say) Sweden or Canada. Thus, our ETM firms are often born at a disadvantage in world terms. Then they have to contend with the high and fluctuating dollar and, in addition, the high interest rates used to control the economy at a macro level. Historically, protection was seen as the answer; in today's increasingly integrated global economy, it is clear that protection does not work. However, to expose firms that were nurtured in protected times to open competition, especially abruptly, is likely to lead more often to their closure than to their transformation into vigorous world-beaters.

- The importance of strong firms to ETM industries, and the critical weakness Australia has in its lack of such firms. The elements of advantage that are key to competitiveness in ETM industries, such as large relative scale, a technological lead or strong brands, are possessed by firms, not countries. Aside from BHP Steel, Australia has a great lack of strong firms of significant size in tradeable ETMs. This critical weakness makes our situation very different from those of countries such as Sweden or Canada, with which we might be compared.

- The prevalence of entrenched "bad practice" in Australia. The fact that most people are employed in either non-tradeable sectors or highly protected manufacturing industries has enabled practices and attitudes that are very uncompetitive in international terms to flourish among business, unions and government. Our productivity is relatively low and our quality often mediocre. The causes of this are deeply entrenched in our society and will be difficult to overcome.

- The many artificial barriers to realising the unexploited potential of the resources sector. An extraordinarily low proportion of the raw materials we produce are transformed into higher value commodities in Australia: aluminium rather than alumina, paper rather than woodchips, tops rather than greasy wool. Still less is converted into differentiated products with much higher value added.
auto parts (from aluminium), speciality foods, worsted yarns. Only developments of this kind offer the potential for large export increases that will close Australia's trade gap. Yet adding value to resources is constrained in many artificial ways: through unworkable environmental approval processes, high costs of investment capital, high-cost power and transport, high construction costs, unreliable and inefficient ports and agricultural marketing arrangements that often impose import-parity prices and narrow quality ranges on products that could be transformed to higher value-added forms.

Any one of these problems might be readily surmountable on its own, but together they pose a truly formidable challenge. Scaling down of protection has been a positive step, as will be further micro-economic reform, particularly in dealing with the barriers to further processing of resource products. However, to meet the challenge and transform Australian manufacturing into a modern, competitive industrial sector integrated with the world, a third element of strategy is essential. This involves a series of positive measures to address the critical weakness of Australian industry we referred to above and to promote the development of a larger number of strong firms exporting high value-added goods.

The central policy recommendation of this report for the Federal Government is to establish an explicit linkage between three key dimensions of policy:

- Increasing exposure of industry to international competition through progressive phasing-down of protection
- Reforms to reduce impediments to industrial development
- Positive measures to promote the development of a larger number of strong export firms in complex factor industries

The accompanying central messages for State governments, businesses, unions, education institutions and the scientific, financial and legal communities are that a greatly increased pace of change is necessary in Australian manufacturing and supporting industries, that integration with world industry is essential for Australia's long-term prosperity, and that international competitive benchmarks (and not domestic ones) will be what count in the future.

This report has eight chapters, which are organised into four parts. The principal ideas and recommendations it contains can be summarised as follows:

**Part I:** As a starting point, a clear understanding of the significance, the competitive position and the potential of Australian manufacturing is needed. This part contains two chapters, which discuss

- In Chapter 1, the importance to Australia of its manufacturing sector, the performance of the sector and the way this relates to its structural competitive position
- In Chapter 2, the potential growth of the sector and the economy by the year 2000 if the recommendations set out here are implemented.

**Part II:** In the second part, we set out the arguments for progressively increased exposure of Australian manufacturing to international competition, linked to the reforms of Parts III and IV.
In Chapter 3, we recommend a progressive phase-down of protection, as outlined in the Government's May 1988 Economic Statement, and that

After the expiry of the present plan, protection of TCF should be brought more into line with that for the rest of industry, and automotive protection should be reduced under the special conditions described below

General reductions from 1992 onwards should be linked to the rate of progress in micro-economic reform and be directed at developing more strong export firms

As the level of Australian protection will then be comparable with those of most Western nations and below those of many of our Asian neighbours, the debate over protectionism need no longer maintain the predominance it has had for a century. The proposal of the Garnaut report, to aim for zero tariffs and no anti-dumping provisions by the year 2000, should not be adopted. It would provide negligible impetus to economic growth while imposing a rigour on tradeable goods manufacturing that is out of line with international norms and the rest of the Australian economy. This could also cause a flight of resources from tradeable manufacturing over and above that which the trade deficit suggests has been happening for a good many years.

**Part III:** In the third part, we recommend reducing impediments to industrial development, which are of several kinds

In Chapter 4, we recommend accelerated dissemination of the "New Workplace Culture". This represents international "best practice" in manufacturing, but can currently be seen in Australia in only a handful of the best managed firms. It involves a combination of: advanced technology; techniques such as Just-in-Time and Total Quality Management; high rewards for skill and commitment to skill development; flexibility of workplace organisation; and employee empowerment through use of work teams and greater devolution of decision-making responsibility. To accelerate its dissemination, a number of actions are required

- Creation of a new vision for industry, especially among managers, by international comparisons, publicity and positive examples
- Refocussing and restructuring of the whole national skills training system so that it will be driven more by its users, i.e. industry and the workforce
- A rapid move by consensus to a new industrial bargaining structure, with unions rationalised along broad industry lines and mixed centralised and enterprise level bargaining.

In Chapter 5, we recommend creating a financial environment more favourable to long-term productive investment, particularly in tradeable goods industries. Investment in
industry in Australia is now severely impeded by high inflation and a high real cost of investment capital. The causes of these problems are complex and the remedies are beyond the scope of this report, but for a healthy and vigorous economy remedies must be found. In the interim, we recommend two targeted counter measures

- A depreciation incentive for investment in large capital intensive export projects, mainly in resource processing
- Risk Sharing support to help overcome the financial barriers to penetrating difficult export markets for value-added products.

In Chapter 6, we recommend reducing infrastructure impediments and improving the efficiency of non-tradeable sectors. Several specific impediments that at present slow the expansion of raw materials processing industries and high value-added manufacturing should be reduced. Most important are the needs for

- More workable processes for environmental evaluation, consultation and approval, which must link State and Federal responsibilities and take account of related heritage, Aboriginal and local planning concerns. Although shared with other countries, this need is most critical for Australia: it is we who need to lead internationally in establishing "best practice"
- Faster and greater improvement in the reliability and efficiency of our ports than under the present reform program
- In plant construction, the freeing-up of imports of modules and equipment items, linked with agreement among industry, government and unions to provide support for developing focussed engineering capabilities
- Power tariffs that better reflect the costs of serving industrial users, which could best be established through greater contestability of the generating market and more efficiency in the electricity sector, including the use of more interstate trade in power
- Reduction of transport costs, especially in trans-Tasman shipping costs, through further freeing-up of restricted trade
- Reform of agricultural marketing to open up flexibility in pricing and product qualities and to provide a better base for export-competitive value-added processing in Australia

Part IV. In the fourth and final part, we argue for a range of positive measures to overcome the key weakness of Australia's manufacturing sector

- In Chapter 7, we recommend use of positive measures to help create a larger number of strong export firms in high value-added manufactures. The measures recommended are:
Assistance to competent exporters to penetrate difficult markets through Risk Sharing support, i.e. advances to fund up to half of market development program expenses, reimbursable with interest or by profit sharing if successful

Sustained tax support for R&D (not to be eroded by imputation) and some increase in non-tax support linked to continuing the trend to more industry/government collaboration

Maintenance of the modest flow of venture capital while steadily increasing the level of professionalism and experience in this market

Expansion of strategic procurement to help develop potentially defensible industries, providing certain strict conditions apply

Programs to promote networking and otherwise assist smaller firms to become export-capable

In Chapter 8, we recommend specific policies to integrate Australia better into global scale industries, namely the automotive, computer and telecommunications equipment, aerospace and pharmaceutical industries. Australia has a trade deficit of over $10 billion in these products. These industries are characterised by powerful scale economies, and Australia is not a natural home for them, but in some instances can play a specialised role through intervention at little cost to the economy.

Priorities among these industries need to be set by weighing the potential benefits to the trade balance and "externalities" (or linkage benefits) against the the cost of intervention to the economy. The automotive industry ranks highest in priority, the information equipment industry second, and aerospace and pharmaceuticals after them. Other global scale industries in which Australia has no great competitive strength or potential do not warrant such priority.

In the car industry, a new long-term framework is needed post-1992. The major task is to promote more integration with the global industry. This could be achieved through partnership agreements, under which signatory companies would gain duty-free access in return for commitments to produce or source products here in proportion to their local sales. They would probably specialise their local production more narrowly, exporting more than now, and import the wide variety of products the market requires. Tariffs would remain, but would be phased to considerably lower levels.

The existing partnership agreements in information equipment and Industry Development Arrangements in telecommunications equipment are in Australia's interests. The former should be strengthened by more consistency in government purchasing. The partnership principle should also be applied to strengthening Australia's presence in aerospace, while in pharmaceuticals only minor changes are suggested in the Factor F program.
Positive assistance is required to assist firms with the major adjustments demanded over the coming decade and to neutralise the impact of impediments not yet eradicated. These impediments include distortions created by past protection, which impose hurdles in addition to the natural ones for would-be manufacturers of tradable goods. In addition, there is a need to offset the worst impact of "unlevel playing fields" elsewhere. (For example, the only world car industry not protected is Japan's, and it was heavily protected earlier in its development). We need also to acknowledge that competitive advantage in complex factor industries is not a black and white notion, but rather that there are grey areas in which incentives can facilitate the creation of competitive businesses at relatively low initial cost to the nation, and that industrial development depends on the external benefits that individual firms bring to the web of markets that they buy from and serve.

* * *

As might be expected in a project as broad as this, and in which the constituencies are so varied, we have received a great deal of advice as to how the research material should be presented. Unfortunately, the advice is extremely varied: the report should be brief or fully argued; explicit in policy recommendations or broadly "directional"; addressed primarily to economic policy makers or to business and union leaders; focussed on a few key recommendations or comprehensive in its vision. The report that follows is not brief as it aims to fulfil the expectations of audiences requiring a considerable amount of evidence.

After a year of analysis, debate and refinement of these and the other recommendations of the report, we are confident that they can help shift Australia towards a better trade balance and greater long-term prosperity.

In carrying out this study we have drawn heavily on previous work by many others in this field: in particular, that by the Department of Industry, Technology and Commerce and the Industry Commission. Similarly, the assessments contained in the Garnaut and Hughes Reports and a wide variety of other government, business and union publications have provided a strong base to which we have added our contribution.

We wish to acknowledge the specific contributions made to this study by a great many people: the members of the Australian Manufacturing Council, and particularly its Executive, as well as the members of the Industry Councils and the Reference Groups set up for the study, all of whom have given generously of their time; the hundreds of other businessmen, public officials, union leaders and experts, both here and overseas, who have provided time, advice and information; and especially the staff of the AMC Secretariat under Mr Bill Mountford, who have provided invaluable support. We are very grateful for the assistance of all these people, without whom the study could not have been successful, but we ourselves accept responsibility for the interpretation we have made of the information they have provided and the conclusions we have drawn.

Yours sincerely

Colin Carter David Pecaut Ralph Evans
APPENDIX III

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Computer Power Group

Dr John Bell  
Department of Industry, Technology & Commerce

Dr Paul Brock  
Office of the Minister for Employment, Education & Training

Mr Joe Burke  
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Mr Ian Castles  
Australian Statistician

Dr Greg Clark  
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Mr Campbell Coo  
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Mr Tony Cole  
Chairman, Industry Commission

Dr David Cook  
ANSTO

Mr Julian Cribb  
The Australian

Ms Karen Curtis  
ASTEC

Mr Henry d'Assumpcao  
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Mr Alex Dix  
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Pappas Carter Evans and Koop

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Mr Patrick Walters
Office of the Minister for Transport & Communications

Mr Laurie Wiggins
Office of the Minister for Industry, Technology & Commerce
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<th>Abbreviation</th>
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<tr>
<td>BIE</td>
<td>Bureau of Industry Economics</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<tr>
<td>DFAT</td>
<td>Department of Foreign Affairs and Trade</td>
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<tr>
<td>ETM</td>
<td>Elaborately transformed manufacture</td>
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<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>IIS</td>
<td>Information Industries Strategy</td>
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<td>MITI</td>
<td>Ministry of International Trade and Industry</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
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<tr>
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