The Contribution of Science and Technology to Australia's Balance of Payments to the Year 2000 – The Manufacturing Sector

1989
The Australian Science and Technology Council (ASTEC) is a statutory authority of the Commonwealth Government. The Council is the Government's principal source of independent advice on a wide range of policies and programs related to science and technology. The fifteen members of the Council are drawn from science, industry and the trade union movement. They are supported by a full-time secretariat.

ASTEC provides advice to the Government by way of formal reports, which are tabled in the Parliament, and through letters and briefing notes sent to the Prime Minister. In addition to this formal advice, members of the Council and the secretariat produce occasional papers on subjects of general interest in the area of science and technology. These papers are intended to stimulate discussion and debate on significant scientific, technological, economic and social issues.
Key Technologies and their role in Economic Development of Small Countries, W J McG Tegart, May 1988

Superconductivity, I R Shortt, July 1988

After the Myers Report: Improving the Management of Technological Change, August 1988

Government Purchasing Policy and Industrial Innovation, October 1988

The Contribution of Science and Technology to Australia's Balance of Payments to the Year 2000 - Service Sector, January 1989


The Contribution of Science and Technology to Australia's Balance of Payments to the Year 2000 - Manufacturing Sector, February 1989
PREFACE

The escalation of Australia's level of foreign debt in recent years has highlighted the need for structural changes to the nation's economy, so that the production of goods and services is more closely attuned to the demands of domestic and overseas customers. Greater export orientation and import replacement will be required of industry if the nation is to reduce its foreign indebtedness.

There are many factors which will contribute to improved competitiveness of the Australian economy; the development and application of new technologies is one of these factors. Product innovation, embodied in new or improved devices, and process innovation, which acts to increase the efficiency of production, both influence industrial competitiveness. New technologies also enhance the range of final services available to consumers and the input of intermediate services to the production of goods in other sectors of the economy.

ASTEC is undertaking a study of the contribution that science and technology could make to Australia's economic development and balance of payments situation to the year 2000. This study will examine the perceived growth potential of economic sectors, the role that science and technology could play in such growth, and the barriers to maximising these market and technological opportunities.

Studies relating to primary, manufacturing and service sectors are being conducted and papers describing the Council's findings are being prepared and circulated for comment. When these comments have been considered, an Overview Report will be prepared, which will develop further the findings of the separate sector studies and will highlight factors likely to have a pronounced influence on international and domestic markets, sectoral linkages and major science and technology issues.

This Occasional Paper covers ASTEC's review of the manufacturing sector.

Comments on this and the other papers reporting on this study are warmly welcomed and should be addressed to:

The Secretary
Australian Science and Technology Council
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Queen Victoria Terrace
CANBERRA ACT 2600
## CONTENTS

<table>
<thead>
<tr>
<th>Executive Summary</th>
<th>Pg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What's Happening In World Manufacturing?</td>
<td>1</td>
</tr>
<tr>
<td>2. Manufacturing In Australia</td>
<td>8</td>
</tr>
<tr>
<td>3. Technology In Manufacturing</td>
<td>20</td>
</tr>
<tr>
<td>4. Manufacturing In The 1990s</td>
<td>27</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

In the 1980s, manufactured goods have been the fastest growing area of world merchandise trade.

Strong growth occurred in categories of office and telecommunications equipment, road motor vehicles, clothing, household appliances and consumer goods.

Prominent features of manufactures trade include:

- Significant intra-industry trade; that is, manufactured exports are frequently components rather than a final product for the wholesale or retail market. Manufacturing is both an import and export activity;
- OECD trade comes increasingly from sectors that benefit from economies of scale, and whose products are highly differentiated and have substantial scientific and technological inputs;
- Newly industrialised countries (NICs) are becoming major exporters of both traditional manufactures (e.g., textiles, clothing) and elaborately transformed manufactures (e.g., electrical goods, motor vehicles).

In terms of world trade:

- The faster growing product categories are likely to be manufactured goods;
- Within manufactures, fast growth areas span the full range of comparative advantage, from labour intensive to capital and technology intensive.

Global Factors Influencing Manufacturing

Increasing internationalisation of manufacturing has seen the location of production become highly flexible, with companies moving various activities to those places where they generate the greatest return. Combined with allied trends towards customisation, this provides many opportunities for niche marketing.

Factors which are influencing the size and shape of world manufacturing include:

- The emergence of the NICs as major producers and exporters of manufactures;
- The development and utilisation of a broad array of advanced technologies;
- The growing importance of transnational corporations;
- Increasing defence needs;
- Structural adjustment problems in many countries;
- The formation of trading blocs and regional alliances;
- Environmental factors.

Specific factors which affect the competitiveness of Australian manufacturing include:

- A small but geographically scattered domestic market;
- Large distances to export markets;
- A resource-based economy;
- A dominance of small firms.
- a high degree of foreign ownership in manufacturing, particularly in the high R&D-intensive sector;
- a low level of overall trading activity.

**Manufacturing in Australia**

The contribution of manufacturing to GDP has fallen steadily from 29% in 1960 to 17% in 1987. Similarly, manufacturing employment has decreased from 39% of the workforce in 1960 to 16% in 1987.

- in the 1980s, the fastest growing areas, in terms of industry product, have been associated with a declining labour force.

The major industries in manufacturing are:
- food processing;
- paper, printing and publishing;
- basic metals;
- transport equipment.

Production, exports and profitability have all increased in the last two or three years, resulting from a mixture of favourable exchange rates, efficient production and a more outward-looking orientation.

This improved performance has not been uniform, with 'spikes' of export activity occurring in a diverse range of industries. Included in these categories are:
- industries where Australia could be expected to have a competitive advantage (aluminum production, processing of agricultural products);
- mature industries where innovation has created a new market (clothing – Ken Done, Maggie Shepherd; motor vehicles – Kelpie Industries);
- sophisticated high technology industries (medical goods – Nucleus; biotechnology – Agen, Genelink; microelectronics – Teknis, Labtam);
- industries in which Australia is highly competitive due mainly to entrepreneurial efforts rather than inherent comparative advantages (brewing – Bond, Elders; building materials – Boral; ink – National Consolidated).

Within this diverse grouping, several interesting trends are evident:
- the increasing prominence of large, Australian-based transnational corporations;
- increasing direct foreign investment by Australian companies;
- more frequent instances where products are conceived and designed in Australia but manufactured overseas;
- use of modern technology to rejuvenate mature industries.

**Technology**

Business enterprise expenditure on R&D (BERD) has risen rapidly in recent years, reaching $1189 million in 1986–87.

- manufacturing enterprises accounted for $686 million of this total R&D effort.

The level of BERD in Australia is one of the lowest in the OECD, when expressed as a percentage of GDP.
such comparisons, however, take no account of the structure of the Australian economy, with its bias towards primary and service sectors, and towards low R&D-intensive industries in manufacturing.

When structural differences are taken into account, it appears that investment in manufacturing R&D in Australia is generally satisfactory (as a proportion of value-added) for the low and medium R&D-intensive Industries, but substantial increases are needed in the high R&D-intensive sector.

- in this regard, one of Australia's main disadvantages is the small size of firms in high technology areas.

Structural adjustment will require the vigorous growth of industries which produce goods with a high value-added content.

- Government policies will need to reflect this growth imperative, rather than giving undue attention to investment in R&D per se.

Manufacturing in the 1990s

Manufacturing will continue to be composed of a mixture of industries that reflect our natural advantages, domestic market requirements and lifestyle, and the results of individual initiative or invention.

Given the worldwide dominance of large companies in the high technology sector, it will be difficult for Australia to achieve significant compositional change in its industrial base towards high technology.

Increasingly, opportunities for manufacturing will arise from linkages with other sectors of the economy.

- services can assist manufacturing through increasing the size of the market, providing authoritative endorsement of Australian-made products, and stimulating development of uniquely designed products.

- further processing of Australia's raw materials and primary products will also benefit local manufacturing.

Seizing these opportunities will require:

- commitment to high quality production;

- increasing the level of workforce skills;

- greater investment in advanced technologies;

- overcoming the intense pressure that financial markets and shareholders place on the short term performance of Australian companies;

- developing products that are innovative and rely heavily on non-price factors for their competitiveness, to overcome exchange rate volatility due to our commodity-based currency.

ASTEC considers that government policy should focus on the need to increase exports from the sector as a whole, gradually moving towards a restructuring that gives greater weighting to high value-added goods.
greater attention needs to be given to 'market-price' measures, and to a better understanding of what is necessary to realise international business opportunities.

There are a range of specific measures which could aid the performance of Australian manufacturing in the 1990s.

**Export assistance:** enhanced export market development assistance and the expansion of information/market intelligence gathering;

**Government procurement:** developing a 'strategic' approach to procurement, through an understanding of the international environment facing domestic suppliers and recognising the most critical leverage points for gaining a competitive advantage in their business.

**Strategic alliances:** in addition to present measures to facilitate to alliances between Australian firms and foreign counterparts, great national benefit could arise from collaboration between small firms and the emerging group of Australian TNCs.

- Government could focus on such a 'domestic strategic alliance' to enhance the opportunities for small companies through the inherent advantages of the largest.

- this cooperative approach could be reinforced through greater efforts to develop consortia in Australia.

**Skills formation:** present initiatives will need to be expanded so that skills shortages do not act as a barrier to future manufacturing expansion.

Science and technology: maintenance of an adequate science and technology infrastructure will be critical to the on-going competitiveness of industry, and to restructuring towards a higher value-added economy.
1. WHAT'S HAPPENING IN WORLD MANUFACTURING?

Manufacturing plays a key role in economic maturation. Nations tend to develop through an initial expansion of manufacturing relative to primary industries, followed by an increase in the size of the service sector compared with both primary and manufacturing sectors. Thus the direct contribution of manufacturing as a proportion of national production and employment can be expected to rise at first, peak and then gradually decline towards a fairly stable level.

Such a simplistic description of the evolution of economies, however, conceals several important features of manufacturing development. Despite a reduction in relative size (but often not in absolute terms), manufacturing makes significant indirect inputs to the national economy through links with both primary and service industries. In particular, the production of agricultural products, processing of raw materials and the provision of services are often inextricably linked to goods produced in the manufacturing sector. New product and process technology is also developed in manufacturing and transferred to other sectors.

A simple transition model of the economy also underplays the heterogeneity of manufacturing and the changes within the sector that tend to coincide with certain stages of development. Initially, developing nations base their competitiveness on low cost labour supplies, and produce goods that reflect this input; for example, mass produced goods which show little differentiation, with competitiveness based primarily on price factors. As increased prosperity begins to influence wage rates, nations are forced to draw on other factors of production in which they have a competitive advantage. In this regard, product innovation, embodied in new or improved devices, and process innovation, which acts to increase the efficiency of production, are common features of leading industrial nations. In addition to technical innovation, changes in activities such as distribution, marketing, finance and management (ie services) can contribute to overall industrial innovation and competitiveness.

In this way, industrial restructuring throughout the world is a function of changes in product composition and of geographic location. A country's need for steel, for example, is higher in the early stages of industrialisation than in its more mature stages and so unless export markets can be expanded there will be a natural slowing of the growth of steel production. In addition, in the past two decades technological change has intervened to reduce demand for steel through improved design and improved properties. This represents a move toward electronic rather than mechanical controls and the substitution of other materials for steel. Energy conservation measures have also influenced demand.

These transitional shifts are clearly illustrated by trends in world production and trade of manufactured goods. In volume terms, for example, manufactures trade was twelve times larger in 1980 than it was in 1950, whereas trade in mining and agricultural products was only five times and three and a half times larger, respectively[1]. During this period, world trade in manufactures grew at a rate about 50% higher than the growth in production.
During the 1980s this trend continued, with manufacturing maintaining its dominant role as the fastest growing area of merchandise trade for all years, except 1986 when mining products assumed this position (Fig 1.1). Over this period, growth in manufactures was particularly strong in the categories of office and telecommunications equipment, road motor vehicles, clothing, household appliances and consumer goods (Fig 1.2).

Regional composition of manufactures trade reflects the state of industrial evolution of constituent countries. Traditional manufacturing is the province of newly industrialising countries (NICs), where labour costs are low. In the textile, clothing and footwear industries, for example, much of the 20 percent increase in world trade during the five years from 1980 came from the Asian NICs. On the other hand, OECD trade comes increasingly from sectors that benefit from economies of scale and whose products are highly differentiated and have substantial scientific and technological inputs.

Importantly, OECD countries have tended to specialise within industries rather than between them, as the global market place enables a large number of competing suppliers to subsist because many differentiated products can be produced without any undue loss of economies of scale. About 30 per cent of the OECD's manufacturing trade with the NICs was in intra-industry trade. In other words, manufactured exports are frequently parts of goods rather than a final product ready for the wholesale or retail market. Partly as a result of this, the NICs have increased their export share of many of the fastest growing categories of manufactures, through final assembling of imported components[2].

In its analysis of this merchandise trade in the 1980s, the secretariat of the General Agreement on Tariffs and Trade (GATT) concluded that[3]:

- even during periods of slow growth in total world trade, world market demand for some products will be growing rapidly;
- the faster growing products are likely to be manufactured goods; and
- within the category of manufactures, the fastest growing products span the full range of possible comparative advantage, from labour intensive to capital and technology intensive.

Naturally, local comparative advantage will influence the extent to which individual nations can achieve export success. In general, however, there are opportunities for countries to enhance economic growth through diversification and expansion of manufactures exports.

**Global Factors Influencing Manufacturing**

On a global basis, manufacturing is being influenced by the general internationalisation of economic activities. The location of production has become highly flexible with companies moving various activities to those places where they generate the greatest return. This mobility allows a company, or nation, to specialise in a particular part of the production process rather than being involved in the entire process. Combined with allied trends towards customisation, this can provide many opportunities for niche marketing.
Fig 1.1
GROWTH OF THE VOLUME OF WORLD MERCHANDISE TRADE AND PRODUCTION BY MAJOR PRODUCT GROUP, 1960-86

(Average annual percentage change)

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<thead>
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<tbody>
<tr>
<td>EXPORTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>4</td>
<td>4(\frac{1}{2})</td>
<td>1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Mining</td>
<td>7</td>
<td>1(\frac{1}{2})</td>
<td>-1(\frac{1}{2})</td>
<td>-2</td>
<td>(\frac{7}{2})</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10(\frac{1}{2})</td>
<td>7</td>
<td>4(\frac{1}{2})</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>All merchandise</td>
<td>8(\frac{1}{2})</td>
<td>5</td>
<td>3</td>
<td>3(\frac{1}{2})</td>
<td>3(\frac{1}{2})</td>
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<tr>
<td>PRODUCTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>2(\frac{1}{4})</td>
<td>2(\frac{1}{4})</td>
<td>2(\frac{1}{4})</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mining</td>
<td>5(\frac{1}{4})</td>
<td>2(\frac{1}{4})</td>
<td>-1(\frac{1}{4})</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>7(\frac{1}{4})</td>
<td>4(\frac{1}{4})</td>
<td>2(\frac{1}{4})</td>
<td>3(\frac{1}{2})</td>
<td>3(\frac{1}{2})</td>
</tr>
<tr>
<td>All merchandise</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Fig 1.2
WORLD MERCHANDISE EXPORTS BY PRODUCT GROUP, 1980-86

(Percentage shares and average annual percentage change in value)

<table>
<thead>
<tr>
<th>Share in world merchandise exports</th>
<th>Product group</th>
<th>Average annual percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1980-86</td>
</tr>
<tr>
<td>1986</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.7 Office and telecommunication equipment</td>
<td>12(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>9.2 Road motor vehicles</td>
<td>7(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>2.9 Clothing</td>
<td>7(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>5.2 Household appliances</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5.5 Other consumer goods (furniture, leather goods, etc.)</td>
<td>5(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>11.9 Other machinery and transport equipment</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>9.0 Chemicals</td>
<td>3(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>3.1 Textiles</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>8.7 Machinery for specialized industry</td>
<td>2(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>4.9 Other semi-manufactures (manuf. of wood, paper and rubber)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>World merchandise exports</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10.7 Food</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3.5 Iron and steel</td>
<td>(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>3.4 Raw materials (crude rubber, wood, etc.)</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>1.6 Ores and minerals</td>
<td>-4</td>
<td></td>
</tr>
<tr>
<td>1.9 Non-ferrous metals</td>
<td>-4(\frac{1}{2})</td>
<td></td>
</tr>
<tr>
<td>12.7 Fuels</td>
<td>-9</td>
<td></td>
</tr>
</tbody>
</table>
In addition, internationalisation has implications for the way in which companies conduct business. Greater importance is placed on strategic planning, corporate alliances and financial, marketing and managerial skills. Also, linguistic abilities and knowledge of social and business cultures have become integral parts of commercial expertise.

A diverse array of other factors is also influencing the size and shape of manufacturing throughout the world. These include:

- **The emergence of the Newly-Industrialised Countries (NICs) as major producers and exporters of manufactures.** In many cases, these nations have invested heavily in the most modern manufacturing technology, building upon the inherent competitiveness gained from an abundant supply of cheap labour. They now produce goods ranging from simple manufactures (eg footwear, clothing) to elaborately transformed and technology intensive manufactures (eg electrical goods, motor vehicles), with quality standards at internationally competitive levels.

- **The development and utilisation of a broad array of advanced technologies.** These include information and telecommunications technologies, biotechnology, new industrial materials and advanced manufacturing technologies such as robots, computer-aided design and computer-aided manufacturing. These technologies are very significant in a strategic sense and offer the potential to change significantly the competitive standing of individual nations.

- **The growing importance of transnational corporations.** These corporations, collectively, are increasingly becoming the source of technology transactions. Importantly, OECD studies show that technology transactions between associated firms are most pronounced in research-intensive industries, which are closely associated with product innovation; for example, electrical engineering, computers and electronics. Conversely, technology transactions between independent firms are predominantly in traditional industries and industries with many small firms; for example textiles and metal working[4].

The overall pattern of present technological development appears to be one of increasing concentration, based mainly around these large transnational corporations, but with signs of increasing collaboration (especially in R&D) between them as a response to the escalating costs of product development. What is new about this arrangement is the number of such co-operative agreements and the extent to which they involve proprietary areas and corporate strategies.

- **Defence Needs.** Escalating defence requirements are having major impacts on manufacturing. While most defence research and development is aimed at developing specific weapons systems, a significant part is directed to developing generic technologies which can be applied to both military weapons and civil products. This includes advanced technologies in areas such as computers, VLSI circuits, fibre optics and advanced materials.

Dual purpose technologies are raising difficult issues at the international level. These centre around national security considerations and associated efforts to control and restrict the trade of such products, and the transfer of technology and know-how. The free flow of basic research results is also being challenged in some areas by these national security concerns.
Structural adjustment problems. Many nations are facing balance of payments problems and are restructuring to meet the challenge of the export economies of the NICs and Japan. Deregulation of financial systems and market determined currency levels are introducing new uncertainties to these changes. In addition, the debt problems of third world countries and their inability to trade may pose major problems for world trade in the next decade.

Trading Blocs. Various nations are moving towards the formation of extended markets, usually characterised by very low (or zero) barrier protection levels across borders within the group while retaining higher levels of protection for trade with nations outside the group. The European Economic Community (EEC), the European Free Trade Association (EFTA) and United States/Canada are examples of such trade alliances. Concern has been expressed that future trading arrangements could be dominated by large trading blocs, much to the detriment of non-bloc nations.

Environmental Factors. Economic activities, whether for production or consumption or as a means of disposing of wastes, change the environment. There is increasing support for the concept of sustainable development; in vigorously pursuing the development process there must be a recognition that its continuation depends critically upon maintenance of the underlying environment and resource base. Growing world concern over the Greenhouse Effect and the generation of hazardous and intractable waste can be expected increasingly to favour manufacturing and raw materials processing being located close to the energy and feedstock sources. This will offer countries like Australia the manufacturing options with higher pollution, waste and energy intensity.

On the other hand, environmental concerns can stimulate innovation and product development aimed at alleviating these problems. Global environmental and energy issues represent a global market for innovative manufacturers.

The Competitiveness of Small Countries

The importance of market demand, critical mass in R&D and an increasing presence of transnational corporations in technology development have implications for manufacturing in all countries, but particularly those with small economies. Small domestic markets require firms to export in order to gain the benefits of large scale production and to recoup the substantial up-front costs associated with product development, especially products with a high R&D content. The higher this initial investment, the earlier that a product is likely to need export markets.

Due to the size of their domestic market, small industrialised countries are more dependent on foreign trade than large ones. As shown in Table 1, there is generally an inverse relationship between the size of an economy and the extent of its trading activities. Australia is an exception to this generalisation, having a trade performance only 25%-50% of the relative levels of other small OECD nations.
TABLE 1. IMPORTS AND EXPORTS AS PER CENT OF GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports as per cent of GDP</th>
<th>Imports as per cent of GDP</th>
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<tbody>
<tr>
<td>1 Belgium/Luxembourg</td>
<td>62.3</td>
<td>65.0</td>
</tr>
<tr>
<td>2 Netherlands</td>
<td>49.6</td>
<td>46.5</td>
</tr>
<tr>
<td>3 Ireland</td>
<td>48.2</td>
<td>51.1</td>
</tr>
<tr>
<td>4 Iceland</td>
<td>33.2</td>
<td>36.7</td>
</tr>
<tr>
<td>5 Norway</td>
<td>32.7</td>
<td>24.5</td>
</tr>
<tr>
<td>6 Sweden</td>
<td>29.9</td>
<td>28.4</td>
</tr>
<tr>
<td>7 Denmark</td>
<td>28.4</td>
<td>28.8</td>
</tr>
<tr>
<td>8 Switzerland</td>
<td>26.4</td>
<td>30.0</td>
</tr>
<tr>
<td>9 Germany</td>
<td>25.8</td>
<td>23.3</td>
</tr>
<tr>
<td>10 Finland</td>
<td>25.4</td>
<td>26.0</td>
</tr>
<tr>
<td>11 New Zealand</td>
<td>23.2</td>
<td>22.6</td>
</tr>
<tr>
<td>12 Austria</td>
<td>23.0</td>
<td>28.9</td>
</tr>
<tr>
<td>13 Canada</td>
<td>22.8</td>
<td>18.9</td>
</tr>
<tr>
<td>14 Portugal</td>
<td>22.0</td>
<td>38.7</td>
</tr>
<tr>
<td>15 Italy</td>
<td>20.6</td>
<td>22.8</td>
</tr>
<tr>
<td>16 United Kingdom</td>
<td>20.2</td>
<td>22.0</td>
</tr>
<tr>
<td>17 France</td>
<td>17.6</td>
<td>20.2</td>
</tr>
<tr>
<td>18 Australia</td>
<td>14.0</td>
<td>13.9</td>
</tr>
<tr>
<td>19 Greece</td>
<td>12.9</td>
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<tr>
<td>20 Japan</td>
<td>12.7</td>
<td>10.9</td>
</tr>
<tr>
<td>21 Spain</td>
<td>12.5</td>
<td>18.4</td>
</tr>
<tr>
<td>22 Turkey</td>
<td>11.6</td>
<td>18.9</td>
</tr>
<tr>
<td>23 United States</td>
<td>6.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Source: OECD/ABS

While all small countries are facing difficulties in maintaining technological competence and competitiveness, Australia has a combination of characteristics which provides problems unique to this group. These include:

- a small but geographically scattered domestic market;
- large distances to export markets;
- a resource-based economy;
- a dominance of small firms;
- a high degree of foreign ownership in manufacturing, particularly in high R&D intensive sectors; and
- an extremely low level of overall trading activity.
This situation is markedly different from small European countries, which generally benefit from regional market proximity. It also differs from Canada, a similarly large, resource-based economy, in that Canada shares a border with the largest single-country market in the world.

ASTEC considers that this uniqueness requires policies and programs based on a detailed knowledge of the structural composition of the Australian economy and the innovation processes within these industries. Unfortunately there appears to have been less emphasis placed on this topic than would seem desirable; in many cases an extrapolation of overseas experience is used rather than examining the country's specific characteristics. Little empirical information is known about the contribution of innovation to Australia's economic growth, the linkages between technology-push and demand-pull in specific industry sectors, lag times between "best practice" and "average practice" applications of technology, or the impacts that the internationalisation of science and technology is having on national policies in these areas.

ASTEC supports an expanded research effort in this broad area by government and academic institutions.
2. MANUFACTURING IN AUSTRALIA

A comprehensive range of manufactured goods could be found in Australia in the decade after the last war but there are now many items for which we are totally dependent on imports and this pattern is expected to continue. Manufacturing industry's contribution to GDP has fallen steadily from 29% in 1960, to 19.7% in 1980, and further to 17.3% in 1987. The fall in level of employment is even more dramatic, from 39% of the workforce in 1960 to 16% in 1987. The growth of the service sector has offset this relative decrease in manufacturing employment.

In the last three or four years, there has been a revival in the performance of manufacturing. Production, profitability and exports, especially elaborately transformed manufactures, have risen significantly. Even manufacturing employment has increased. This enhanced performance has occurred due to a range of factors, including the impetus provided by the devaluation of the Australian dollar in 1985–86, together with the introduction of government programs aimed at increasing the international competitiveness of Australian companies.

The components of the manufacturing sector in Australia are shown in Fig 2.1. The largest industry is food processing which alone produces one fifth of the gross product of manufacturing industry. Paper, printing and publishing; basic metals; and transport equipment and other machinery, all produce about 10% of the gross product. As indicated in Fig 2.2, output growth in manufacturing is not necessarily related to growth in employment. In the eighties, the fastest growing areas in terms of industry product have been associated with a declining labour force.

Especially in times when commodity prices are buoyant, as is presently the case, the question is often posed, 'why manufacture at all?' We consider that manufacturing is important for four main reasons;

. **The importance of manufacturing for the balance of payments.**

Manufactured goods is the fastest growing area of world trade and much of this trade is centred on the neighbouring Asia-Pacific region. Manufacturing is, therefore, an area with enormous opportunities. On the other hand, the largest gap in our balance of payments is in high technology products, and this gap is growing rapidly as the service sector expands. The resources market is unlikely to expand to balance the increasing import bill and so our dependency on the export of manufactures and services must increase.

. **Adding value to primary products**

Much of Australia's primary industry exports is unprocessed or, at best, semi-processed. Additional processing can build on the comparative advantages that Australia has in these areas, as well as generating products that are differentiated from their competitors and encompass greater value-added. Areas such as those requiring substantial energy inputs (eg, aluminium industry), and the food industry show much potential in this regard.
Linkage with services

Many services are inextricably linked with manufacturing both within the production process and in servicing the needs of management. This service element is an increasingly important aspect of manufacturing; the knowledge gained from adaptation and use of the product represents important information for the manufacturer in meeting client needs and staying ahead of competition. In addition, manufactures, especially those related to information technology, form the basis for the delivery of many social and economic services.

Encapsulating human creativity

Much of our ingenuity and science is captured in manufactured products. If manufacturing capability is lost then the return on new developments is much reduced through sale or licensing at an early stage. Furthermore, the scope for further development may also be lost.

In addition, the employment generated by manufacturing is important. Although the manufacturing sector's share of total employment has been declining for many years, the sector still employs more than 1.1 million full-time workers. Given the flow on effects in other sectors, this represents a very important source of jobs.

Trade in Manufactures

In recent years, exports of manufactures have risen significantly, particularly elaborately transformed manufactures, including goods which embody a high degree of technological transformation. There is a long term upward trend in the propensity to export and, in recent years, export volumes have increased considerably faster than aggregate output. It appears, however, that many goods are dependent for their profitability on the dollar value staying at historically low levels and may not survive a sustained upswing in commodity prices.

Fig 2.3 shows the export performance of the principal manufacturing industries.

Manufacturing in itself involves imports. High labour cost components are often imported from low labour cost countries, and standard components which benefit from large scale production are also imported. There are other components which are made so well and cost effectively in one place that they supply most of the world. A large proportion of the manufacturing machinery used in Australia is also imported.

The import cost of modern manufacturing demonstrates that a policy of manufacturing for import replacement is not sufficient. While import relacement can be attempted in a number of areas, a series of recessions since the sixties have narrowed our manufacturing capabilities and capacity. This also places a number of constraints on the extent to which Australia can pursue a high growth strategy without running into balance of payments problems.
Foreign investment

The last decade has seen increasing levels of overseas investment by Australian companies, primarily in response to the growing globalisation of many industrial activities. Investments have been made to:

. establish manufacturing in low labour cost countries. This is particularly true of labour intensive operations such as clothing and footwear. Products like toasters are being made in China from designs produced in Australia; in this case, exports for the world market will come from China while manufacturing in Australia will be for the home market only.

. establish manufacturing near to markets. The major advantage is ready access to market information on customer preferences, as well as awareness of the situation of use, fashion and other market determinants. Transport costs are also reduced. Such investment also circumvents import barriers that may be erected by governments to protect local industries.

. assist in the development of markets and provide a service base. Sophisticated goods require customisation and client education as well as back up services. These may be a significant part of value added and are best provided close to the customer where language and cultural differences can be accommodated.

. enable companies to expand offshore by making use of larger markets and larger shareholder bases.

Similarly, investment in Australia by foreign owned firms is growing to serve the local market, and sometimes the region, and to capture some of the technology or inventiveness of Australians.

Fig 2.4 shows that investment from Australia is going predominantly to the USA and the EEC and that this trend is increasing. The majority of foreign investment into Australia also comes from these two areas. The contribution of investment going to manufacturing is modest compared with investment in mining and finance sectors[5].

Trends in Australian Manufacturing

As mentioned above, several features of Australia's manufacturing performance stand out. Production, exports and profitability have all increased in the last two or three years, resulting from a mixture of favourable exchange rates, efficient production and a more outward looking orientation.

This improved performance has not occurred across-the-board. There is considerable variation between industries, and within industries, even down to the level of individual firms. In general, niche marketing has been dominant (which is not surprising given the 'small country' problems faced by Australian manufacturers), often with only one Australian company competing for a particular market segment.
Fig 2.4a
FOREIGN INVESTMENT BY COUNTRY
1986-87

Fig 2.4b
AUSTRALIAN INVESTMENT OVERSEAS
Levels of Investment by Country

Into Australia
Out of Australia

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$A Million

10000
20000
30000
40000
50000
60000

USA
NZ
EC
Hong Kong
PNG
Other

Other Countries
ASEAN
OECD Other
UK
USA

$A Million
10000
20000
30000
40000
50000
60000
Penetration of export markets has occurred in a diverse range of industry sectors. This includes:

- industries where Australia could be expected to have a competitive advantage. For example, processing of raw materials (especially aluminium), where cheap energy has assisted local production, and in processing of Australia's agricultural products.

- mature industries where innovation has created a new market. For example, Maggie Shepherd and Ken Done have both developed export strengths based on creative designs. In motor vehicles, Kelpie Industries has designed a utility tray-top that is capable of being lowered to the ground; in conjunction with Chrysler of the US, this represents a billion dollar export.

- sophisticated high technology industries. Many small companies have made initial forays into the export market. Nucleus, the medical goods manufacturer, is probably the best known, but an array of companies in areas like biotechnology (eg Agen, Genelink) and microelectronics (eg Austek Microsystems, Labtam, Teknis) are increasing their export presence.

- industries in which Australia has contrived to be internationally competitive. In industries like brewing (Bond, Elders), building materials (Boral), and high quality ink (National Consolidated) Australia is highly competitive, due mainly to entrepreneurial efforts rather than inherent comparative advantages.

These 'spikes' of export activity across the industry spectrum have several common features. There is generally a strong export-orientation and a detailed understanding of the target markets; in some cases, such drive can be traced back to the vision of a single person. The most successful companies also have the strong marketing, finance and administrative strengths that are required to operate international businesses.

Within this diverse grouping, several interesting trends are becoming evident. These include:

- the increasing prominence of large, Australian-based transnational corporations;

- the increasing direct foreign investment by Australian companies;

- more frequent instances where products are conceived and designed in Australia and manufactured overseas;

- use of modern technology to rejuvenate mature industries.

In many cases, these activities are linked and represent a natural progression towards a closer integration of the Australian economy into global markets.

An analysis of large Australian companies shows that very few are in manufacturing as their main line of business. Most are based on resources and services such as banking or transport. The larger manufacturing companies produce building materials, paper and pulp and processed food. In general, our manufacturing companies are small, although recent mergers are beginning to change that situation.
Australian successes

The following sections illustrate in more detail some areas which have significant growth potential over the coming years.

Australia now has a number of indigenous transnational corporations. These have grown out of our natural comparative advantages in resources and agriculture, but many are demonstrating growth of secondary strengths especially in the services area. BHP, for example, is one of the largest mining and metals groups in the world. It has interests in iron ore, coal, steel, gold and petroleum. In the eighties it formed a number of new business groups which capitalised on the skills and technologies developed in core businesses. These are mainly service activities such as BHP Transport and BHP Engineering. Although the major steel producer in Australia, manufacturing is only a small part of the company's activities.

The Elders group is a major brewer, but otherwise is essentially a service company, specialising in providing multiple services to the client. This developed from a rural industry base in Australia to encompass primary production marketing on the world scene. Elders is one of the fastest growing Australian companies, and is now well established overseas.

Success in building materials follows from our need for such materials to be supplied locally due to the cost of transport for bulky items. The steady population increase through immigration and rising living standards provide a reliable level of demand for these materials. Demand should increase through the rapid growth of tourist infrastructure. There is enormous scope for development of housing for the regional market and the exploitation of our expertise in building for the tropics. New technology and the use of new materials will continue to enhance the insulating properties of building materials. On the whole, competition has ensured that this is a competitive sector of the economy and that new technology is incorporated into production. A natural development of the supply of materials is to move into construction and related services.

Paper and pulp depend on our natural resources of timber and have developed largely to supply local needs. Further development of this industry is dependent on the availability of timber and the choices we make about conservation and reafforestation. The paper and pulp industry is one of the fastest growing industries in the world and there are indications that Australia is on the verge of an investment boom in this industry which will considerably enhance our capacity for import replacement and export expansion.

The food processing industry is also dependent on our primary sector. The larger firms operate internationally, where there is enormous scope for further development to meet market niches, especially in Japan and to a lesser extent Asia.

These industries have built on our comparative advantages in the resources and agriculture sectors. There are opportunities for manufacturers to develop further these industries which are based on natural comparative advantage, through the use of skills and technology developed in mining and extraction industries, the exploitation of our market dominance in wool, gourmet foods and other exotic products, the development of remote communities and housing designed for tropical conditions. On the service side there is enormous opportunity for manufacturers in providing the infrastructure needed for tourism and the increased market supplied by this industry.
High technology industries

High technology is a high growth area of international trade. It is very competitive as products emerge in short succession, each one more sophisticated than its predecessor. The information area is dominated by large transnational corporations but there are abundant opportunities for niche products in the field. Software applications are used in an amazing variety of applications and become components in more traditional manufactures. Biotechnology, after a slow start, is beginning to change the production processes for a number of chemicals and new medical applications are being developed. Many of the high technology fields in which Australians are showing promise are developments of our traditional areas of research strength – agriculture and medicine.

In Australia, the high technology field is dominated by small firms which, in addition to the usual difficulties small firms have in attracting management skills and finance, also need to maintain a high level of costly research and development (R&D). The last ten years has seen a progression of small companies launched only to fail a few years later. The rate of failure has increased since the stockmarket crash of October 1987 when funding for risk ventures virtually dried up. This Spartan experience is not helpful in the development of these industries. Similar experiences of small American firms in attempting to develop high technology products have been blamed for the slower development of high technology products there than in Japan where the larger firms are able to apply their strengths in manufacturing to produce new high technology goods.

The more successful small, high technology firms are owned or have substantial backing from larger firms, often in unrelated fields. They are able to develop their technology further with access to a larger source of capital, and management and marketing expertise.

It is in the area of high technology industries, particularly in information technology, that there is the greatest discrepancy in Australia’s the balance of trade. It seems very unlikely that we can compete with the major players by manufacturing major hardware items, but it is possible to offset some of this balance through the export of related services such as software. The recent Partnerships for Development Scheme is an attempt to link Australian activity in this field into the international networks through the involvement of transnational companies. These companies agree to commit to R&D in Australia a sum equal to 5% of Australian turnover and achieve exports equal to 50% of their imports. Exports must have an average Australian value-added content of 70%. The Partnership Scheme will also enhance the research community in this area and link Australia more effectively into overseas networks.

Two high technology industries that show much potential are the 'medical' industry and the 'defence' industry.

(i) Medical

Our society accords enormous prestige to the medical profession and has encouraged the brightest students to study medicine and then to move on to medical research. The earliest publicly funded research in Australia was in medicine and funding has continued to grow faster than for other areas of scientific research. Only limited attempts have been made so far to exploit this strength (some examples are outlined in the companion service sector report where the potential for the provision and export of medical and educational services is discussed).
Central to the development of a vertically integrated 'medical' industry is the development of a medical and scientific instruments manufacturing industry. This industry has demonstrated enormous potential for exports and is moving in a concerted fashion to increase its capabilities and export markets.

There are around 600 firms in this field but only a dozen have more than 100 employees and here the average is around 200. Many are very small and about 30% are less than 5 years old. In general, medical equipment is concentrated in Sydney, scientific equipment in Melbourne and optical equipment in Adelaide. Each has developed a local market where their competition comes from imports rather than from another local producer. These scientific and medical research companies have grown out of local research and maintain a strong commitment to it. They usually have strong linkages with the universities and CSIRO.

In addition, these companies have export targets which double over the next three years and are brave enough to offer projections to the end of the century. Their difficulties are serious, however, and reflect difficulties common to many other industries in Australia. These include:

- difficulty in getting skilled staff, particularly engineers and especially those with electronic and industrial experience, and also skilled tradespeople;
- the lack of a good light engineering capacity in Australia, particularly since the depression in 1982;
- the problems of small start up companies – lack of capital, business skills, difficulty in finding resources for overseas travel to establish business links;
- low profitability, partly due to high levels of R&D but increasingly caused by difficulties in attracting investment funds.

Through the leadership of the Electrical, Electronic and Information Council, these industries have developed a Strategy for Development. Many of the recommendations are for developments within the industry and involve leadership from representative bodies. The joint sponsorship of trade expansion programs and a structure which facilitates the formation of consortia for specific contracts is an important advance and helps to reduce the problems of small companies.

One of the more exciting possibilities is the development of consortia which offer both training and equipment supplies. The focus is on high standard equipment used in most hospital laboratories, not necessarily state of the art instruments for advanced research. It is likely that the latter will remain the preserve of a few well established high technology companies. Furthermore, the use of Australian-made equipment in hospitals by Australian students and those from overseas, provides confidence in the Australian product and a familiarity which may encourage later overseas sales. Use in Australia also provides an endorsement of quality which is a major asset for overseas sales.
It is disappointing, therefore, to find that there is little interest in buying Australian in these publicly owned institutions. The practicalities of insisting on an Australian procurement policy have so far been judged too difficult. This is an important area and further thought should be given to government involvement in introducing Australian-made technology to these institutions.

(ii) Defence Industry

The Department of Defence has recently reviewed its policy on defence purchasing.

"It is the policy of the current Government to encourage the widest possible cost-effective involvement of Australian industry in defence work"[6].

Australian manufacturing industry participation in defence contracts offers the prospect of substantial industrial benefit in terms of an increase in capability established for subsequent work, repair, maintenance, modification, refit etc. Participation in defence projects brings to manufacturing industry important technologies, introduces new skills and equipment, and develops expertise in areas of project management and quality control. These attributes in turn, produce a more viable production base, as well as access to new technology and markets.

In addition, through the Government's offsets policy technology transfer and work to the value of 30% of the imported content of a project, must be placed with Australian industry.

The largest defence contract let in Australia to date is the Australian submarine project. The Australian Submarine Corporation (ASC) as a private company (50% Australian owned) will undertake the design and build the new fleet of submarines for the Royal Australian Navy. ASC is aiming for an Australian content of about 70% for the propulsion system, weapons discharge, ships management, software design and other sensors systems, with Australian companies involved in design and manufacturing in all areas. The total value of the subcontracts let to date approaches $1.4 billion although some concern over maximising Australian industry involvement still persists.

Over the 12 year life of this project, and the six type 471 submarines to be built for $3,900 million, Australian companies working in support of the project will also increase their opportunities in other areas because the project involves a wide range of manufacturing skills and technologies. For example, the production of modules of the submarine involves complex large-scale fabrication techniques of the highest precision to meet strict standards of structural integrity and quality. Local manufacture of ancillary items varying from pumps, valves, electrical controls, batteries, air and water treatment, programmable controllers, will all introduce Australian industry to new materials and new methods of manufacture. The economic and manufacturing aspects of this project are enormous - the project is worth nearly $4 billion at 1986 dollar values, and will have major benefits in manufacturing industry rejuvenation and growth.
An interesting spin-off in the services context is that each submarine will need a major refit every 5 years. This means that by 1998 industry will have contracts worth $50 million to refit a submarine each year, currently amounting to one million hours of work. In addition, it is expected that the ASC consortium will go on to develop other projects which are indirect spin-offs and perhaps this developed capability will lead to production which is quite unrelated to the submarine 471 series.

With a price tag of $A5 billion and a commitment to local construction – up to 70% of all component, equipment and systems – the ANZAC frigate project represents another enormous vehicle for technology transfer and skills development.

Other examples of defence related activities include:

1. the recent linkage between AWA Limited and the South Australian Government, which have formed Australia’s largest defence electronics contracting group – termed the AWASA Defence Industries. This comprises four existing enterprises with a combined current annual turnover of $100 million. The group comprises people employed by AWA, Thorn, EMI Electronics and Fairey Australasia, C-3 Pty Limited, as well as specialist skilled groups in electronics, optics and acoustics. This group will compete for defence contracts such as the ANZAC ship project, the submarine contract, the FA 18 Hornet and the Black Hawk Helicopter valued at over $12.5 billion. It will also bid for $1.3 billion of projects associated with Australian electronics defence systems.

2. Aerospace Technologies of Australia (ASTA), which has signed a $US300 million joint venture with French Aerospatiale to manufacture and market light helicopters, guided missiles and airborne surveillance systems as well as to assemble and test the F/A-18 fighter aircraft. This joint venture will capture a significant slice of the world market and ASTA’s share in the project during the next twenty years could create export earnings well in excess of $1,000 million. The ASTA (formerly the Government Aircraft Factory) is clearly moving in line with Government attempts to develop the manufacturing base in Australia through joint ventures with overseas companies.

From these examples it is clear that defence spending can be a valuable mechanism to enhance the international competitiveness and export awareness of Australian companies. These developments will prompt individual companies to adopt new quality assurance measures, new technologies, new training programs and new ideas about their future.

Changes in the level of Australian involvement in defence supplies flow directly from the Government’s decision to source more capital equipment in Australia and to build a vigorous and competitive local defence industry. Almost $2 billion per year (27% of the total defence budget) is currently spent on capital equipment compared with an average of 15% back in the 70s – the proportions spent in Australia have to climb to over 40% and are likely to reach 50% within the next three years.
3. TECHNOLOGY IN MANUFACTURING

The use of technology is linked to the efficiency of manufacturing, the quality of items produced and the national capacity for innovation. While there is no single indicator which can quantify technology usage, there are a number of indicators which, taken together, provide a reasonably comprehensive picture of the technological intensiveness of industry. These indicators include business enterprise expenditure on research and development, levels of investment in manufacturing, especially plant and equipment, trade in technology-based goods and payments for technical know-how.

Research and Development

Research and development (R&D) is related to technological development and utilisation. An in-house capability in R&D not only provides the basis for innovation, but allows a company to adapt imported technology, to licence technology from other sources, to participate in exchange sharing arrangements and to participate in contractual R&D issued by other companies or public sector institutions.

Expenditure on total business enterprise R&D (BERD) has risen rapidly in recent years, reaching $1189 million, or about 0.42% of GDP, in 1986–87. Of this expenditure, $686 million (0.24% of GDP) came from manufacturing enterprises, $452 million (0.16% of GDP) from services enterprises and $51 million (0.02% of GDP) from mining companies[7].

Despite these improvements, the level of business enterprise expenditure on R&D in Australia is one of the lowest in the OECD, when expressed as a percentage of GDP. In fact, total Australian BERD is less than manufacturing BERD for many OECD nations; the OECD small country average is 0.7% of GDP, and the large country average is 1.4% of GDP [8]. International comparisons like these have highlighted the relative lack of spending on R&D by Australian companies.

How Much R&D Should Australian Industry Perform?

Recent analysis of industry structures by the OECD has shown that 'similar industries in different countries show a more uniform response to R&D and to other factors than do different industries in the same country'[9]. Companies operating in industries associated with the early stages of innovation cycles will invest heavily in R&D (typically 5–10% of their turnover), regardless of their national location, because R&D is a major factor in the competitiveness of these industries. Conversely, companies in mature industries, or resource based industries, will invest less in R&D (often less than 1% of turnover).

The prevailing industrial structure, therefore, plays a major role in determining the amount of R&D that a country will perform. Highly aggregated international comparisons take no account of the structure of the Australian economy, with its bias towards primary and service sectors, and towards low R&D-intensive industries in the manufacturing sector.

Recent work by the Commonwealth Department of Industry, Technology and Commerce and the OECD[10] takes the industry structures of OECD nations into account, and casts new light on Australia's relative investments in R&D, and plant and equipment.
This study found that, in terms of R&D intensity (i.e., R&D as a proportion of value-added), a number of Australian industries are comparable with similar industries in both large and small OECD nations. In high R&D-intensive industries, Australia compares well against Germany, Italy, the United Kingdom and Canada in instruments; against Canada in pharmaceuticals; and against Italy and the United Kingdom in electrical machinery. In medium and low R&D-intensive industries, Australia also compares well with several countries in motor vehicles, chemicals, other manufacturing and ferrous metals categories. Overall, however, Australia's R&D intensity was below both large and small country averages in all industries except one ('other manufacturing'), with the difference being the greatest in the high technology industries.

Based on the industry structure prevailing in 1984–85, the report developed notional targets for manufacturing BERD in Australia. These targets corresponded to 0.4% of GDP (using small countries as a base reference) and 0.5% of GDP (large country basis); that is, the actual expenditure of 0.22% of GDP ($441 million) needed to be doubled if the nation was to be competitive in R&D, for Australia's particular industry composition, in 1984–85.

Taking into account several anomalies between Australia and other nations (e.g., the small size of the Australian space industry, the high proportion of BERD accounted for by services companies, especially Telecom, which in other nations is often attributed to manufacturing) closes the gap between actual and notional R&D levels. Strong growth in manufacturing R&D since 1984 may also have decreased the gap, although compensating high growth in R&D expenditure has been evident in virtually all other OECD nations.

Overall, therefore, investment in manufacturing R&D in Australia appears to be generally satisfactory (as a proportion of value-added) for the low and medium R&D-intensive sectors, but substantial increases are needed in the high R&D-intensive sector. In this regard, one of Australia's main disadvantages is the small size of firms in R&D-intensive areas; this casts doubt on our ability to compete in high technology areas in the short term.

The preceding analysis suggests that Australia's apparent low level of business enterprise R&D, as a proportion of GDP, is caused by a mixture of factors: the predominance of industries which intrinsically do not need to conduct large amounts of research to remain competitive (or which rely heavily on publicly funded research institutions), and a low level of R&D intensity in individual industries, particularly in high R&D-intensive industries.

Structural adjustment will require the vigorous growth of industries which produce goods with a high value-added content. Government policies will need to reflect this growth imperative, rather than concentrating solely on investment in R&D per se.
Manufacturing Investment

Private investment in plant and equipment, as a proportion of Gross Domestic Product, has consistently been lower in Australia than in many OECD nations. Over the ten year period from 1974, for example, average annual investment in plant and machinery was about 10% lower than the average for OECD nations, and even further below countries like Denmark, Sweden and Finland. It is interesting to note that over this period the level of Gross Fixed Capital Expenditure attributed to residential construction (as a percentage of GDP) in Australia was one of the highest in the OECD.

Levels of investment in manufacturing are cyclical and have just recovered from a major downturn in 1983, following the recession of 1982/83 (Fig 3.1). Preliminary estimates for 1986–87 indicate that real growth in total manufacturing investment was of the order of 4%, with the strongest growth in paper and printing, chemicals, basic metals and transport equipment. The combination of the relatively high cost of capital in Australia and the recent changes in depreciation rates (deduction over the life of the asset) may delay future investment and, therefore, technology upgrade, as it is now cheaper to repair old equipment and keep it running as the cost can be fully deducted in the year it is incurred.

Investment in plant and equipment is one measure of the introduction of technology into the workplace. In itself, it does not provide a competitive advantage; this can only come from the skills and knowledge of the people who use it. Investment in plant and equipment by ASIC groups shows a steady rise in most categories and evidence of a significant rise recently (Fig 3.2). There is evidence to suggest that much of this investment is going into improved production processes leading to cost reduction rather than to increased output. In some cases this has been accompanied by a reorganisation of work practices and organisation.

Utilisation of Technology

Unfortunately, there is little information on comparative technology acquisition at the industry level in Australia. At a more aggregated level, trade in technology-based manufactures provides some information, although imports include demand for technology in services and primary industries. In 1985, for example, Australia imported US$9165 million of technology-based products, representing US$54.9 worth of imports per thousand US dollars of Gross Domestic Product. This compared relatively favourably with the OECD average of US$61 per thousand US dollars of local GDP, and was certainly more in line than our exports of technology-based goods (only US$0.57 per thousand US dollars of GDP, compared with the OECD average of US$50.02).

Such trade figures should be treated carefully as they give little detailed information about the underlying industry structure. The case of Ireland illustrates this point. In 1985 Ireland exported US$4.6 billion of technology-based products, with US$3.5 billion worth of imports, representing more than a billion dollar surplus. Despite this export performance, and the concomitant creation of 80,000 jobs, only four transnational companies have more than ten people employed in R&D activities in the country. Ireland has become a giant, high technology assembling plant primarily for the EEC market.
Fig 3.1
REAL GROSS INVESTMENT IN MANUFACTURING

Real gross investment by manufacturing
(index: March 1970 = 100.0)
In some cases, the most appropriate means of acquiring technology is through licensing and further local development. Payments for technical know-how by Australian manufacturing companies have doubled in the period 1981/82 to 1986/87, and now total $217 million per annum. However, on a normalised basis, this is still well below many other OECD countries.

These two indicators, imports of technology-based products and payments for technical know-how, suggest that most technology is bought 'off-the-shelf' for unadapted use in Australia, rather than through licensing for further local development, and possibly subsequent export.

**New Technology in Manufacturing.**

The global market for manufacturing automation is big – around $41 billion and increasing rapidly. The investment in items such as material handling equipment, machine-vision systems, process controls, robotics, and manufacturing software are expected to total $19.4 billion in the U.S. alone (a 13% increase from 1987) and forecasts of U.S. investment in manufacturing in 1989 indicate an expansion of 14%, to $22.2 billion.

The advantages of automated equipment and flexible manufacturing systems (FMS) include:

- quality improvement – greater precision and consistency than humans can sustain;
- improvement in the working environment;
- better cost effectiveness;
- flexibility to accommodate change – this is particularly important for small batch production.

Manufacturing industry in Australia has to invest in this technology to enhance its ability to compete overseas, in terms of both cost and quality. The introduction of robots and FMS may reduce labour costs but often raises maintenance and overhead costs by much more. The Japanese design products around the limitations of the machines rather than machines attempting to copy products made by people. Their robots tend to be simpler, less sophisticated and have less demanding duties than those of U.S. or Europe. Australian manufacturing is characterised by relatively short production runs, requiring systems which:

- deal with rapid design changes and product innovation;
- include robot configurations with peripheral devices offering the desired flexibility without high cost or complexity;

Australia presently has around 950 installed robots, compared with only 122 in 1980. Robots, rather than being seen as 'people displacers' are being used increasingly to lift repeatable quality standards, increase flexibility for short production runs and to alleviate the workplace of either heavy, repetitive, dangerous or dirty work.
Examples from current applications indicate the pervasive range of this technology — BHP’s massive materials handling unit at the Port Kembla strip rolling mill; Comalco’s fully integrated automatic aluminium extrusion plants; Ford’s spot welding units, (which comprise a third of the total); Alcatel-SCC’s telephone assembly unit; Nabisco’s pick-and-place robots for biscuits on the packaging line; the Australian Wool Corporation’s sheep shearing robot and ANSTO’s nuclear waste handling units.

Robot flexibility is particularly suited to Australian conditions since shorter production runs can be built into the programs as well as minor product variations during each run. This is particularly important since product life cycles are becoming shorter as a general feature all over the world. Since the bulk of Australian manufacturing is done by small to medium sized businesses employing between 10–50 people, the emphasis is on flexibility principally because of uncertainty about the future product type.
The manufacturing sector in Australia will continue to be composed of a mixture of industries that reflect our natural advantages, domestic market requirements and lifestyle, and the results of individual initiative or invention. At present, statistics tend to hide the high points as they are scattered amongst the also rans; increasingly they will show out as our manufacturing capacity becomes 'hollowed out' with the onset of reduced tariff protection. The restructured manufacturing sector will be much more outward looking and adept at international marketing but will remain concentrated in the medium and low technology end of the spectrum. High technology industries will continue to grow, but given the worldwide dominance of large companies in this field it will be very difficult for Australia to achieve significant compositional change in its industrial base towards high technology.

Despite likely contraction in some areas of manufacturing, there will be many opportunities for niche marketing, especially products that are differentiated from their competitors and embody creative design and innovation. The proximity of the rapidly advancing Asian market will also provide many opportunities, both in the form of new markets and through increasing potential for combining Australian design with low cost Asian manufacturing.

Increasingly, opportunities for manufacturing will arise from linkages with other sectors of the economy. Service industries can enhance the development of manufacturing through increasing the size of the market (tourism, for example, generates enormous demand for information technology products, construction materials and consumer goods), provide authoritative endorsement of Australian-made products (eg, in medical and educational services) as well as stimulating development of uniquely designed products (eg, construction designs created especially for the Australian climate and conditions). The emergence of large, Australian-based transnational service companies in recent years provides manufacturers with a core of leading-edge customers who can be major facilitators of local innovation.

Conversely, manufacturing can provide tremendous opportunities for further service activities. The principle is most easily understood in relation to the follow up service activities generated by the family car and is particularly true of high technology manufacturing.

Closer links with primary industries in further processing of Australia's raw materials will also provide opportunities for manufacturing. The location of such processing (ie whether in Australia or closer to the end-market) will depend on the dynamics of each situation. Factors like our relatively abundant and low cost energy supplies, and transport savings associated with processing close to the source of the primary product point to some advantages in Australian-based processing. On the other hand, capital costs, user requirements (eg foreign government establishment rules) and tariff effects on value-added goods often mean offshore processing is the best investment for Australian companies. While both forms of investment see profits generated by Australian companies, the major employment gains to the nation obviously come from processing that is located in Australia.
Seizing these opportunities will not be easy or simple. The intense pressure that the financial markets and shareholders place on the short term performance of Australian companies often acts against the commitment of the resources necessary for product development and subsequent securing of export markets. Also, the close link between commodity prices and the exchange rate, and the 'cleaness' of the currency float, represent an inherent volatility which adds to the risks involved in planning 5 or 10 year ventures (these factors have meant that the Australian dollar is somewhat of a gambler's currency for speculation on commodity markets; the dollar is the fifth or sixth most traded currency in the world). This volatility reinforces the desirability of developing products that are innovative and rely heavily on non-price factors for their competitiveness.

For Australian firms to reach their full potential, more emphasis will need to be placed on building organisations capable of consistently producing high quality goods which are timely, meet domestic and international market requirements and are price competitive. This means the emergence of more companies that are capable of breaking through the $100-300 million turnover threshold that seems to signify truly international operations.

Historically, local manufacturers have been disadvantaged by the small size of the Australian market. While the domestic market remains small, several factors are acting to alleviate this scale problem. The assembly nature of some areas of manufacturing now enables Australian companies to buy components from manufacturers who, through specialisation, are able to achieve economies of scale. This may happen within the Australian economy or through importing from low labour cost countries. A further development is the production of the whole item overseas to an Australian design, either by a subsidiary or under licence. This may be the most practical solution for low value items. Where customisation is important, it may be appropriate to manufacture close to the market. For Australia this means that the expansion may not result in growth in manufacturing jobs but it will provide access to another market and opportunities for innovation from that base.

Equally important to Australian manufacturing will be a commitment to high quality production. This can only be developed where there is a commitment to quality at all stages of production. The manufacturing process itself can be improved through research and process innovation, and be a source of a competitive advantage.

Overall, however, the most important resource for the future of the Australian manufacturing lies in its human skills. Our greatest challenge is to increase the numbers of skilled people in the workforce. The current emphasis on restructuring the higher education system and the concern to raise standards of teaching and the retention rate at schools is vital to our future.

The challenges facing Australian manufacturing also have many implications for workplace organisation. Modern manufacturing requires skilled people and a flexible work organisation. Many of Australia's manufacturing companies, however, still give low status to shopfloor personnel, communicated through factors like conditions of employment, standards of dress, hours of work, timekeeping arrangements, restricted access to office areas and movement around the site, and limited consultation between tradespersons and other employees. The result often denies management the opportunity of learning from the experience on the shopfloor. On the other hand, union structures have been a major barrier to change, and to increasing the flexibility of workplace activities.
Training, and changes to work organisation, will be important features of workplace reform. This implies the development of career paths for all employees along which they can move at a pace suited to their abilities and stage in life. This career path will be different from existing ones as management structures become flatter. The opportunity for training and for career structures in manufacturing are slowly being introduced where there is a commitment to the future. These require new kinds of management skills and the support of the educational system. These developments will largely depend on management, unions and their members as well as government adopting a positive approach to award restructuring over the next two years.

Policies for the Future

A number of innovation policy measures presently in place are to be phased-out or scaled down during the early years of the 1990s. The 150% taxation concession for R&D, the Management and Investment Company (MIC) Scheme and many of the specific industry plans are in this category. This will provide an opportunity to assess the needs of industry to the next century and develop policies and programs tailored to these requirements.

In this regard, ASTEC considers that government policy should focus on the need to increase exports from the sector as a whole, gradually moving towards a restructuring which gives greater weighting to high value-added goods. This does not necessarily mean the development of high technology industries per se, but is clearly dependent on Australian firms using technologies most appropriate to their spectrum of activities. While import replacement will also be important, it is unlikely that companies would be able to compete against imports without being participants in the fiercely contested international marketplace. Greater involvement in international business will increasingly develop the kind of productive culture needed for our society to prosper in the 1990s.

When determining the policies and programs which might best be suited to this task, the characteristics of the existing industry structure and performance need to be kept in mind:

- the existing profile of Australian industry is skewed towards low R&D-intensive industries, and low growth industries, compared with other OECD countries;

- on an industry-by-industry basis, it is the composition of manufacturing more so than the exhibited R&D intensity of industries (ie BERD as a percentage of industry value-added) that results in the present low level of industrial R&D when compared with other OECD countries;

- there is not sufficient evidence to support the argument that individual Australian manufacturing industries are less "value added" than elsewhere and levels of vertical integration tend to compare favourably with both large and small country averages for virtually all manufacturing industries.

This suggests that structural change towards a higher value-added economy is likely to be facilitated most easily and quickly through the growth and expansion of industries with these characteristics or potential to develop them, rather than through increasing the scale of inputs without consideration of industry growth requirements.
Against this background, ASTEC sees a central task as being the support of growth in all industries, but especially those in which additional value-added can be derived. Given the small size of Australia’s domestic market, exports and access to foreign markets, either through trade or direct foreign investment, become paramount. In essence, more attention needs to be given to market-pull measures than is perhaps presently the case and to a better understanding of what is necessary to realise international business opportunities.

Central to this philosophy is the desirability of government policy placing greater emphasis on measures that assist and reward output/performance, with less relative weighting on specific inputs to production which can be inefficiently or ineffectively used, yet still qualify for assistance.

This corresponds to industry's general preference for a sale rather than a handout, leaving decisions on allocations of resources to companies but at the same time providing incentives for enhanced performance. If companies are rewarded for performance then they will cater for the inputs that are required. Thus, government would generally focus on market development assistance, with companies concentrating on products and processes.

This does not preclude targeted assistance measures. On the contrary, selectivity in demand measures will automatically generate support for production inputs, without compromising the 'reward for performance' philosophy.

Such an approach could be seen as a natural progression from the regime of programs generated in the last half of the 1980s. In general, these encouraged the development of the underpinning infrastructure in industry, especially in areas like R&D, and capital markets. Far from foresaking this effort, a move towards a more market-pull orientation of government support could be expected to see a more visible return from these earlier investments.

Within this general strategy, recognition needs to be given to small company growth. Manufacturing industry in Australia is dominated by these firms, with almost 95% of firms in manufacturing having less than 100 employees and about half having less than 10 employees. Of the companies performing R&D, about 88% have less than 500 staff. Manufacturing activities in OECD countries are generally undertaken by enterprises far larger than those in Australia (eg, about two thirds of all industrial R&D in OECD nations is performed by companies employing more than 10,000 staff).

In the short term, growth in production and exports is likely to rely heavily on a continuation of the strong revival presently being shown by large Australian firms. Over a longer period, however, more small and medium sized companies (in all areas of industry) will need to grow into larger, export-oriented firms. Overseas experience has shown that close relationships between large and small companies, together with government procurement, are measures which can enhance greatly the growth trajectories of small companies.

Perhaps an exception to this suggested approach is the need to retain some form of R&D assistance for incipient companies to develop their in-house R&D capability; this could be along the lines of the present Grants for Industrial Research and Development (GIRD) Scheme.
The following sections address some of the features which could form the basis of this policy package, without wishing to be overly prescriptive or detailed. At the macro-level, tariffs, regulations and corporate taxation would be important, while at the micro-level efforts could focus on export assistance, government procurement, strategic alliances and skills formation.

Policy Instruments – Macro

(i) Tariffs

Tariffs are perhaps the most discussed feature of Australian manufacturing, although this status seems likely to wane following the Government's comprehensive tariff reduction plans that were announced in May 1988. In general, ASTEC considers that lower tariffs have the potential to enhance competitiveness and encourage an export orientation in local industry, provided that reductions are phased in over time and accompanied by positive assistance arrangements where appropriate. We do not believe that Australian industries should necessarily be sacrificed in any race towards completely free trade. We note, however, that with the exception of the textile, clothing and footwear industries, and the motor vehicle industries, average tariff levels are only of the order of 10-15%, and that these levels have been reduced significantly in recent years.

(ii) Corporate Taxation

The advent of greater internationalisation of manufacturing activities, including increased foreign investment by Australian firms, has highlighted more than ever the importance of prevailing national taxation regimes. In virtually all industries, but especially high technology industries, transnational corporations are showing great flexibility in moving nodes of production to exploit the most advantageous operating environments. This is not new, nor is it confined to the operations of foreign companies; Australian firms are following this strategy as well. It does, however, place in context Australia's efforts to attract foreign investment in manufacturing industries; while not the sole factor in investment location decisions, corporate taxation rates play an important role.

Locally, the prevailing taxation regime influences greatly the profitability of companies and their competitiveness compared with foreign competitors. The government has moved towards a lower marginal tax rate in recent years, primarily at the expense of specific taxation concessions. This approach reinforces the rewards for company performance.

Without wishing to comment further on general taxation matters, we note that some concern has been raised about the bias in the capital gains tax against rapidly growing but very high-risk ventures. In this case, the cash for business expansion is generally acquired through equity funding. The returns to the company are subject to capital gains, even if they are used totally for in-house investment in activities like research and product development. While fully supporting the additional incentive that capital gains tax gives to investment in manufacturing compared to other areas like property, we would be concerned if this tax had a deleterious effect on the growth of small, technology-based companies.
(iii) Regulations

Regulations which affect industry in Australia act primarily to protect consumer interest, to provide for worker health and safety, and to reduce or prevent unwanted environmental impacts. Such regulations, however, can add a substantial element of uncertainty to the operations of innovating companies. This may occur in a number of ways: where regulations are complicated or ambiguous; where there is insufficient information available to industry; where there are frequent or rapid changes to regulations; where there are separate or inconsistent regulatory requirements among the various state and federal regulatory bodies; or where there is a regulatory lag in response to changed technological circumstances.

The Government is presently embarking on a process of deregulation in many areas of manufacturing and services. Such an approach is likely to strengthen the competitive environment in which firms operate, as well as decreasing some of the costs to industry production. While a completely deregulated environment is not feasible, continuing efforts to reduce regulations are likely to have long-term benefits for Australia.

Policy Instruments – Micro

(i) Export Assistance

Australia faces a number of barriers to enhanced export performance which, collectively, place the nation in a unique position compared with other small economies in the world. A low propensity to export, geographic isolation, national fragmentation and a plethora of very small companies (on a world scale) make the task of export expansion very difficult.

Many Australian companies do not appear to have great difficulty in expanding to the limiting production ceiling imposed by the small domestic market (often the order of $10–20 million turnover per annum). Few firms appear to be able to break through this barrier and develop into truly international firms, with turnovers of the order of $100–300 million. In many cases it appears that national resources are spread too thinly, acting against the formation of a 'critical mass' that is required for sustained export development. A more coordinated and concentrated assault on export barriers is required.

In line with the magnitude of this task there are a range of measures which could be used to facilitate greater awareness of world markets and export potential, as well as off-setting some of the high costs of export market development. Some of these measures include:

- enhanced export market development assistance to generate across-the-board increases in exports.

We can see merit in broadening the range of activities eligible for assistance under the Export Market Development Grants Scheme (EMDGS) to include virtually all activities associated with export development. Eligibility criteria could be tightened making it more targetted, performance based and selective for individual companies and products in a broader range of industry sectors including services. It may be appropriate to confine payment to incremental export increases over a single year, or rolling three year base, thus ensuring that windfall profits did not accrue to existing exporters, but still providing an incentive for continuous expansion of export markets.
To meet specific policy objectives, this broad scheme could have several components which provided targeted assistance. For example, structural adjustment to a high value-added economy could be facilitated by special grants to firms whose products exhibit these characteristics, perhaps with an initial moratorium on the incremental export increase requirement to apply to small, innovative firms at the early stages of product development.

Another possible component could include an export research grant, which would assist in determining the export market potential for a product while still in the conceptual or R&D stage. Export research grants could be based on anticipated costs, with the grant being paid in advance to cover an agreed proportion of these costs. This would reduce the cash flow pressures on small companies and at the same time focus attention on market demand at an early stage of product development.

- **Expansion of information/market intelligence gathering capability**

The 'tyranny of distance' acts against Australia's interests in developing export markets, making foreign market information both more difficult and more expensive to obtain. Some resources are devoted to these activities in AUSTRADE and through the Industry, Science and Technology Counsellor network and the newly-appointed investment promotion counsellors, but the scale of these activities is generally surpassed by efforts in many other countries. For example, Finland, a much smaller economy situated closer to major industrialised markets than Australia, has a network of thirteen Industrial Attaches in Europe, the United States and Japan, aimed at facilitating contacts between Finnish firms and foreign counterparts and reporting on the latest overseas results of technological R&D.

In addition, much information on technological and market developments resides in areas of government which are involved in large scale procurement and tendering. Many nations use knowledge gained through the calling of international tenders to much greater national benefit than is the case in Australia. Every effort should be made to unlock knowledge bound within government departments and agencies, and to use this knowledge (within acceptable confidentiality provisions) for the benefit of Australian exporters.

(ii) **Government Procurement**

ASTEC believes that there exists a strong rationale for government to use purchasing policy as a means of promoting industrial development and technological innovation. The enormous purchasing requirements of government can exercise considerable power in determining specifications and standards of quality. We recognise, however, that such policies are often difficult to administer, and therefore costly, and accept that rationalisation of the scheme may be necessary.

One approach to procurement policy which shows great potential is that taken by the Premier's Council of Ontario, Canada, in their review of industrial development in that Province. Noting that price preferences or quotas had done little to build internationally competitive Canadian firms, the Council recommended the utilisation of 'strategic procurement'. In strategic procurement the goal is to assist local suppliers through procurement to broaden their experience, improve their products, reduce their costs, and gain sufficient scale to be more competitive in world markets.
Strategic procurement requires understanding the international competitive environment facing domestic suppliers and recognising the most critical leverage points for gaining a competitive advantage in their businesses. For some companies, new product development is a critical competitive tool. Strategic procurement can help by funding the development of state-of-the-art techniques, testing prototypes and making initial purchases of new products. In other businesses, the endorsement (implied or otherwise) associated with government purchases of local goods is an important factor in subsequent foreign market sales.

While there are aspects of such an approach in the Government's present procurement policies (eg the National Procurement Development Program), more emphasis could be placed on the special needs of different industries, and the ways in which procurement could facilitate the development of internationally competitive companies within these industries.

(iii) Strategic Alliances

Strategic alliances cover cooperative activites of many forms and sizes, ranging from national participation in common market arrangements, through linkages between public and private sector organisations and down to inter-firm activities like collaborative R&D programs, joint venturing and technology exchanges. While the detailed objectives of such arrangements differ, a common aim is to make better use of complementary resources than would likely be the case if each entity acted separately and in isolation. Strategic alliances are likely to be of special importance for Australia, given the scale problems arising from the small, and fragmented, domestic market and the distance from major foreign markets.

Aspects of several existing schemes are acting to enhance the alliances between firms and institutions in Australia. These include the Partnerships for Development program in information industries, the reduced eligibility threshold given to collaborative R&D under the 150% R&D taxation legislation and collaborative research funded under the GIRD program. AUSTRADE's Piggyback Plan, whereby experienced exporters or companies assist the not-so-experienced, is also trying to build new alliances to enhance export activities.

We would like to see the spirit of such collaborative activities permeate throughout Australian industry. In particular, we can see great national benefit from more involvement of major Australian corporations in collaborative activities. Naturally we would not expect these international companies to simply be altruistic or to jeopardise any part of their own activities; rather there is an important opportunity to facilitate another tier in building a 'productive culture' for Australia.

One of the most striking developments over the last five years has been the growth of international operations by Australian–based transnational corporations. Australia's solid core of companies such as TNT, BHP, Elder's, Mayne Nickless, Brambles, Consolidated Press Holdings, Adsteam, Pioneer Concrete, FAI, Bond Corporation and major banks such as National Australia and Westpac have demonstrated the financial, management and administrative strength to successfully operate global businesses.
In a sense, these TNC's have arrived at the objective of industry policy in Australia - they have developed a business base that is of sufficient size for effective globalisation, they are internationally competitive, export oriented and flexible enough to adapt to changing market conditions, and they are also innovative, with a preparedness to adopt new technology, processes and products. Collectively, Australian TNC's represent a reservoir of expertise which can be utilised for national benefit, especially by the wide variety of small and medium size firms in Australia.

This form of "domestic strategic alliance" would offer four major advantages:

- to achieve economy of scale in areas such as marketing or distribution;
- to achieve a complementarity of distribution e.g. technology plus distribution;
- to achieve an international presence for small companies, even if it is de facto by nature;
- to enhance information flows and market intelligence.

In this regard, ASTEC considers that Government could focus on this mechanism to actively enhance the opportunities for smaller companies through the inherent advantages of the largest. Against this broad prescription, ASTEC sees the major task to be the development of a matrix of skills, operations, distribution networks, product endorsements, management expertise, etc. offered by the major companies mentioned earlier.

This cooperative approach could be reinforced through greater efforts to develop consortia in Australia. There are already a number of industry groupings which offer potential as facilitators and we believe they could be used further.

The Heavy Engineering Manufacturers Association discovered that because of their relatively small size, their member companies could tender for only a small part of a major contract. Most large projects are handled by big international industries. They decided to form the Heavy Engineering Projects Corporation of Australia (HEPCA). The objective is to act as a catalyst, bringing together all the disciplines needed to bid for a particular project from engineering design through to equipment supply. It now gathers information on projects coming up around the world and attempts to put an appropriate consortium together to tender for the project. At this stage HEPCA stands back from direct involvement and offers support only.

The medical and scientific equipment (MASE) industry intends to form a coordinated industry association to promote the growth of their industry.

Special industry groups like AgriTec which was sponsored by AUSTRADE should be encouraged in different sectors of industry so as to promote greater synergy in the export effort and the capacity to deliver complete packages of both goods and services.

Longer established associations like the MTIA are developing a stronger leadership role among their members. The establishment of an industry compact with the unions is particularly important. It is possible that it could provide the stimulus to the formation of consortia within its membership.
The defence industry is growing and finding ways of getting together because of the guarantee of a longterm contract which specifies high levels of Australian content. Large government projects should be similarly used to develop Australian capability.

One of the impediments to the formation of consortia in Australia is the poor development of industry information networks. In West Germany, for example, firms are required to submit details of their company capabilities and interests to the local Chamber of Commerce. These records are computerised and linked nationally so that it is possible to target capabilities efficiently. Such networked information would assist the development of consortia in Australia and the more accurate targeting of information. The trade associations should be encouraged to develop such data bases.

(iv) Skills Formation

Australia's future prosperity depends, to a large extent, on making effective use of new technology. This cannot be done merely by installing new machines. New forms of work organisation are needed, and the workforce at all levels needs to be appropriately skilled. There is a welcome recognition of this situation by employers, unions and governments, but much needs to be done to convert this recognition into policies and programs.

Economically successful countries have accepted the need for more education and training, not only in higher levels of formal education, but also in more continuing education by business enterprises. These nations now have more highly skilled workforces than Australia and are in better positions to compete for future market opportunities. Virtually all areas of manufacturing that are showing strong growth are also showing signs of skills shortages. This situation both threatens the output of industries and their profitability, through the higher labour costs arising from scarce resources. Rectifying this position will be crucial to Australia's economic growth over the coming decade.

(v) Science and Technology

The importance of technology in improving the quality of production and the efficiency of the process of production has been stressed in this report because it is important to improve the competitiveness of existing industries. The health and vitality of the underlying scientific infrastructure is also of major importance, as is the linkage of this scientific base to industry. A further ASTEC study will undertake this examination of the core capacity of Australian science.
NOTES AND REFERENCES – TEXT

2. GATT, p18
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Fig 1.1  GATT, International Trade, Geneva. 1987, p10
Fig 1.2  GATT, p19
Fig 2.1  ABS Cat No 5211.0
Fig 2.2  Industries Assistance Commission, Annual Report, 1987–88
Fig 2.3  ABS Cat No 5403.0
Fig 2.4  ABS Cat No 5305.0
Fig 3.1  Bureau of Industry Economics, Submission to the Parliamentary Inquiry into Investment in the Australian Manufacturing Industry, March 1988
Fig 3.2  ABS Cat No 5626.0
In accordance with ASTEC's normal procedures a Working Party was appointed to prepare a draft report for consideration by Council. The Working Party consisted of the following Council members:

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together with:

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The Working Party was supported by Mr Kym Fullgrabe of the Office of ASTEC, and Mrs Christine Paterson and Mr George Dimitriadis, on secondment from the Department of Industry, Technology and Commerce. The Working Party was assisted by interviews and information from the following companies and organisations:

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