Foreword

Ministers' Statement

Australia's science industry is recognized globally for its innovative scientific instruments, clinical diagnostics and laboratory technical services. These are used to ensure the quality of our food, water, air, environment and health, thereby enhancing our everyday lives.

This knowledge-intensive industry is founded on Australia's highly reputed public-sector research organizations. The ingenious people in these organisations developed elegant solutions to the challenges of measuring the properties of matter.

This nucleus of expertise in instrument making became the foundation of Australia's science industry that has grown into the vibrant industry that it is today.

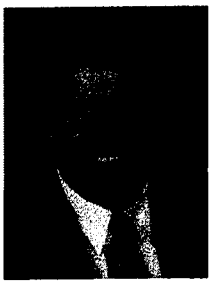
It is an industry that is out performing most others in terms of its commitment to innovation, exporting and workplace excellence. It is the type of industry Australia needs more of.

The action agenda strengthens the links of Australia's science industry supply chain. While all links are currently performing well, the industry's future development potential can be improved by greater collaboration.

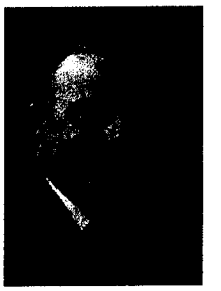
By taking pre-emptive action now to map a growth path for the industry, its leaders have shown the same innovative spirit of their predecessors to unlock the creativity and dynamism that will take this industry into its next generation.

The science industry's leadership and enthusiasm in bringing together the key players in the industry and government to develop this strategic plan is highly commendable.

We look forward to continuing to work with the science industry to achieve our mutual goals of creating a stronger, more sustainable and thriving industry.



The Hon Ian Macfarlane, MP
Minister for Industry,
Tourism and Resource



The Hon Dr Brendan Nelson, MP
Minister for Education,
Science and Training

Chairman's Statement

Australia's science industry has set its sights on continuing to grow at 10 percent per annum for the next 10 years.

Founded on the successful commercialisation of Australia's publicly funded research since the 1950s, the industry has developed globally-recognised strengths in applying leading-edge technology research to the mining and life sciences industries.

The industry's manufacturers and importer/distributors of scientific equipment, laboratory and technical services companies and researchers are performing strongly.

But the industry wants to better itself.

To respond to the challenges facing it and achieve its vision, the industry will enhance internal and external linkages and information flows, pursue the harmonisation of regulations and standards, and strengthen its skilled and flexible workforce.

With this action agenda, the journey for the science industry to realise its vision has already begun.

The road ahead is long. The industry's challenge is to build on the passion, drive and optimism it has demonstrated so far and bring along others who will help the industry reach its goals.

Emeritus Professor Chris Fell AM
Chair
Strategic Industry Leaders Group

Strategic Industry Leaders Group

Emeritus Professor Chris Fell AM
(Chair)

Mr Tom Armstrong
Managing Director
A&D Mercury Pty Ltd

Professor Mark Baker
Chief Executive Officer
Australian Proteome Analysis Facility

Mr Tony Bigum
Chief Executive Officer
Thermo Electron Corporation

Mr Simon Calder
Senior Economist
Australian Industry Group

Mr Phillip Clancy
Managing Director
NIR Technology Australia

Mr Clive Davenport
Chief Executive Officer
Cooperative Research Centre for Microtechnology

Mr Greg Davis
Formerly Managing Director
Varian Australia Pty Ltd

Mr Peter Dawes
Managing Director
SGE International Pty Ltd

Mr Ian Beckingham
Secretariat
Department of Industry, Tourism and Resources

Mr Ray Doyle
Group General Manager
Amdel Limited
(February 2004 - June 2004)

Ms Vonda Fenwick
Manufacturing Operations Manager
GBC Scientific Equipment Pty Ltd
(February 2004 - November 2004)

Mr Paul Field
Director, Biobusiness
ATP Innovations Pty Ltd
(February 2004 - September 2004)

Mr Alan Lawrenson
Executive Director
Science Industry Australia Inc.

Mr Michael Ohanessian
Managing Director
Vision BioSystems Limited

Mr Stephen Pronk
Managing Director
Ai Scientific Pty Ltd

Ms Vicki Tutungi
Deputy Chief Commercial
CSIRO Manufacturing & Infrastructure Technology

Mr Tony van Staveren
Managing Director
Eppendorf South Pacific

Mr Rob McKeon
General Manager
Industry Collaboration on
Department of Industry, Tourism and Resources

Ms Leonie Andrews
Secretariat
Department of Education, Science and Training

Executive summary

"If you can't measure it, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it."

James Harrington

Measurement matters. People want to measure and quantify many things, and there is a seemingly insatiable demand for greater quantification of physical, chemical and biological characteristics, for more accurate measurements, and more reliable measurements. Are our food, water and air contaminated, what are the contaminants, and what quantities are present? Have athletes been using performance enhancing substances? Are our health and medical tests accurate? Do manufacturing processes and products comply with specifications and standards to ensure that customer expectations are met?

The science industry provides the scientific equipment and laboratory services that make these measurements possible.

The industry is defined as research and development, design, production, sale and distribution of laboratory-related goods, services and intellectual capital used for the measurement, analysis and diagnosis of physical, chemical and biological phenomena. The industry provides products and services to many manufacturing and service industries, enabling better informed business and professional decisions that are essential to sustainable economic growth and a better quality of life which we have come to expect.

This knowledge-intensive global industry relies heavily on intellectual property to provide the feedstock for a continuous supply of innovative high value-added world-competitive products, services and processes.

Australia's science industry is well integrated with the global industry and has recognised strengths in providing the instruments and services that can measure very low concentrations of substances present in minute quantities of matter. Some of Australia's scientific instruments have significant global market shares.

The global market for science-related goods was estimated to be AU$95 billion in 2002/03. The global market for laboratory-related services was estimated to be at least as large as the global market for science-related goods.

Two leading global companies that manufacture scientific products in Australia are Varian and Thermo Electron. Others that sell into the Australian market include Abbott Diagnostics, Applera, Agilent Technologies, Beckman Coulter, Bio-Rad Laboratories, Eppendorf, Merck, Mettler Toledo, Perkin Elmer, Promega, Qiagen, Roche Diagnostics, Shimadzu Scientific Instruments, Waters Corporation and A&D Mercury.

Australian science companies that compete globally include Ai Scientific, GBC Scientific Equipment Pty Ltd, Invetech Pty Ltd, SGE International Pty Ltd and Intellection.

Australian laboratory and technical service companies that operate globally include Amdel Pty Ltd, Australian Laboratory Services Pty Ltd, Gribbles Group and Sonic Healthcare Ltd.

Australia's domestic scientific equipment market was estimated to be $3 080 million in 2002/03, of which imports accounted for $2 820 million. Australia's scientific equipment manufacturers' domestic sales were around $260 million, and their exports were $670 million. An element of exports is attributed to the re-export to neighbouring markets of imports to Australia. Around 80 percent of Australian exports of science-related goods are purchased by the US, EU and North Asia. Employment was estimated to be about 8 000.

Australia's laboratory and technical services market was estimated to be $2 960 million in 2002/03, and exports were $110 million. Employment was estimated to be around 39 000.

Australia's publicly funded research organisations also provide significant services to the industry. In 2002/03, scientific research in Australia was valued at $3 077 million and employment was 22 500.

A recent survey indicated that the structure of the science industry reflects that of Australian industry in general - many small companies and few large ones. The total value of turnovers and exports from small and medium sized enterprises (SMEs) and from larger companies are approximately equal.

The survey also indicated that the industry is growing at more than 10 percent annually. Its R&D expenditure of 7.9 percent of annual sales is ten times higher than manufacturing industry's average. Its staff are highly educated by industry standards with almost 50 percent having a bachelor degree or higher, compared with manufacturing industry's average of 13 percent. The industry spends an average of five percent of sales on staff training. Manufacturers, and companies engaged in product maintenance and service, have the highest staff development budgets at eight percent of sales.

In 2003 Science Industry Australia Inc. (SIA) made application to the Government for an action agenda. The proposal was influenced by SIA's involvement in a similar process with the Victorian Government in 2002. SIA recognised the need for the industry's strategic plan to have a national focus.

On 26 February 2004 the Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane and the Minister for Science, the Hon Peter McGauran, jointly announced the development of a Science Industry Action Agenda in partnership with the industry.

The industry, researchers and government have worked together to develop the action agenda by identifying initiatives that would overcome the impediments to the industry realising its full potential. The Strategic Industry Leaders Group, chaired by Professor Chris Fell AM, led the development of the action agenda. It

was ably supported by four working groups that focused their activities on the key issues facing the industry of market development, commercialisation of research, supply chains, and education, training and workplace relations.

The 10-year vision for Australia's science industry is to be cohesive, export oriented and recognised world-wide for its quality, innovation and commercialisation of leading-edge technologies.

To fulfill this vision the industry will be:

- Commercialising a much greater proportion of Australia's research;
- Exporting more than AU$3bn per year;
- Generating revenues of more than AU$5bn per year;
- Growing by an annual average of over 10%; and
- Attracting and retaining world-class scientists, engineers and commercialisers of laboratory technology and services.

Recommendations

The action agenda's recommendations focus on:

- Commercialising a much greater proportion of Australian publicly-funded scientific research;
- Growing exports;
- Improving product and service quality;
- Harmonising regulations and standards relevant to the science industry and aligning them with relevant international ones;
- Attracting and retaining a skilled and flexible workforce;
- Maintaining a set of key economic statistics on the science industry; and
- Implementing the action agenda and improving the industry's internal and external linkages.

These strategic priorities resonate with the Government's *Backing Australia's Abilities* initiatives and its other priorities.

Recommendation 1

Increase significantly the science industry's commercialisation of intellectual property, particularly from publicly funded research.

The science industry is a knowledge-intensive global industry that relies heavily on intellectual property to provide the feedstock for a continuous supply of innovative high value-added world-competitive products, services and processes.

The industry is seeking to increase significantly the economic and social return from Australian public sector research. Greater commercialisation of Australia's publicly-funded research by the science industry will contribute to improving Australia's innovation and investment outcomes.

To improve innovation outcomes, the implementation group's initiatives will be aimed at aligning publicly funded research more closely with the industry's needs, improving communication and understanding between the industry and researchers, and raising the industry's awareness and use of the available support measures.

To improve investment outcomes, the implementation group's strategy will be aimed at improving the entrepreneurial skills of the industry's leaders and managers, and enabling SMEs to gain greater access to finance, particularly venture finance, to fund innovative product and service development and production.

Recommendation 2

Increase the science industry's volume of exports and the number of exporters.

Australia's science industry is highly competitive, reliant on exports and is performing strongly. The major markets are the US, EU and North Asia, which purchase around 80 percent of Australian exports of science-related goods. The value of the industry's exports in 2002/03 was around $1 billion. However, it wants to improve on this. By 2015 the industry is aiming to be exporting $3 billion worth of goods and services. The industry took advantage of a number of Government assistance measures during the development of this action agenda to explore export opportunities and build the capacity of Australian science companies.

To achieve the industry's growth target the implementation group will expand the industry's use of existing resources provided by the industry's commercial linkages, the experience of its successful entrepreneurs and other assistance measures available from industry and government. The implementation group will explore opportunities in the emerging markets of China, other Asian countries, India and South America, and encourage the industry to bring new products and services to market. The implementation group also aims to increase the number of new exporters in the industry by a net 10 per year.

Recommendation 3

Improve the quality of science industry products and services.

Quality is a key determinant of the industry's strategic competitive advantage. However, market needs are in constant flux and remaining at the leading edge requires companies and their suppliers to continuously improve the quality of their products, services and processes, including after-sales service.

The industry considers that a quality mindset should be an enduring aspect of industry culture. This starts with the education and training of the industry's workforce and is reinforced in the workplace.

To improve quality in the science industry, the implementation group will focus its quality strategy on raising the industry's awareness of quality through a variety of measures, and improving the knowledge and skills of the industry's workforce of how to deliver quality commercially.

Recommendation 4

Progress the harmonisation of regulations and standards relevant to the science industry across Commonwealth, State and Territory Governments and align them with relevant international standards.

The science industry relies heavily on international trade. It recognises that a strong regulatory framework that can operate seamlessly with the relevant international regulations and standards is essential to preserving public trust and for trade in the industry's products and services. However, Australia's regulatory framework, as it is currently configured, is a significant impediment to the efficient operation of the market, and imposes costs on the industry that are ultimately borne by the community.

These costs arise from the industry not only having to comply with differing regulations and standards across Australia's nine jurisdictions, but also from having to comply with the many international regulations and standards. The industry is encouraged by the extent of the work that is already underway within Australia and internationally to address this impediment to the industry's growth.

The science industry's particular concerns about domestic regulations and standards are in the variations in the restrictions and the way certain regulations are administered by Commonwealth, State and Territory jurisdictions. Areas of particular concern are certain scheduled poisons, drugs and explosives precursors, in vitro diagnostics, weights and measures and electrical safety. It is also concerned about the lack of a consistent process for formulating and implementing regulations and national codes of practice.

To improve the regulatory environment in Australia for the industry, the implementation group will work with government, other industry bodies and international regulatory reform initiatives by adding the industry's weight to the

shaping of regulatory reform proposals aimed at improving the coordination of regulation development and administration and alignment with international standards.

Recommendation 5

Ensure that the science industry can access the necessary skilled workforce it requires for continued growth.

The science industry like other Australian industries is experiencing a shortage of skilled staff. These shortages have the potential to adversely affect the industry's competitive advantages and its ability to respond to emerging opportunities. The industry's particular shortages are in the areas of laboratory technicians, chemists, engineers (mechanical and software), and sales and management. The industry emphasised that its sales and management staff should have a high level of knowledge and understanding of science and the equipment that the science industry and its clients use. The industry considered that the education and training of undergraduates and trainees lacked sufficient attention to quality and how to achieve it in a commercial setting.

To increase its supply of skilled staff the implementation group will work with Government initiatives such as the National Skills Shortage Strategy and the Audit of Science, Engineering and Technology Skills. It will continue to monitor its skills shortfall situation and advise Government accordingly. It will pursue initiatives to raise the profile of the industry as a potential employer in the feeder groups to its workforce, and improve the content of course curricula to meet the industry's needs. Building stronger linkages between educational institutions and the industry will enable the industry to improve the marketing of its self to prospective staff and to influence course curricula.

Recommendation 6

Sustain flexibility in science industry workplaces.

The science industry comprises predominantly SMEs. Their workplaces are of a high standard compared with others in manufacturing industry. The workforce is highly educated and mobile. The industry values its staff and recognises that they are integral to the industry's long term competitiveness. While many employers in the industry consider that the existing workplace arrangements provide them with sufficient flexibility to manage their companies, they also recognise that as enterprises grow this situation could change.

To ensure that existing flexibilities are preserved and any impediments to competitiveness are removed, the implementation group will work with its industry

colleagues and government to raise employer awareness of the high performance workplace employment model and encourage its adoption by the science industry.

Recommendation 7

Increase the science industry's use of assistance measures available from government and industry.

The industry recognises that many assistance measures are available from government and industry to address impediments to its growth. However, the industry's lack of awareness of these is an issue. During the development of the action agenda, the industry's leaders' became aware of much of what is available. However, more work is needed to raise the wider science industry's awareness of the government assistance measures available.

The implementation group will encourage the industry's constituents to use these existing resources to build their capacity. One such resource of great value is the pool of successful company executives who have a strong desire to share their experience of developing successful export oriented companies to build the industry. The implementation group will develop a mentoring program and expand on the existing informal networking to tap this reservoir of expertise and talent to grow the science industry. Also, the implementation group will continue to advise government on the appropriateness of its policy settings and delivery mechanisms.

Recommendation 8

Maintain a set of key economic statistics on the science industry.

Comprehensive, reliable and current statistics and information on the industry's structure and economic performance are essential to progress the action agenda and monitor its progress. Research showed a lack of readily available statistics and information on the science industry.

To address this during the development of the action agenda, the Department of Industry, Tourism and Resources conducted an industry survey to establish baseline data. The implementation group will continue this work to maintain a current set of statistics and information on the industry.

Recommendation 9

Implement the Science Industry Action Agenda and improve the industry's internal and external linkages.

An implementation group will be responsible for implementing the Science Industry Action Agenda. The implementation group will be led by Science Industry

Australia Inc. (SIA), the industry association sponsoring this action agenda. SIA will provide the leadership for this phase of the action agenda and the secretariat services to the implementation group.

The science industry comprises manufacturers of scientific equipment, importer/distributors of scientific equipment, laboratory and technical service companies and researchers. Individually these fours segments of the industry are performing very well. Scientific equipment and laboratory-related goods are the common element that links these groupings.

These four industry segments operate essentially independently of one another. This fragmentation places limits on the coordination of activities in the science industry supply and value chains and is an impediment to the industry's growth.

For the industry to throw off this constraint and grow as an entity it should develop its own identity and a unity of purpose. A more united industry with strong internal and external linkages will be better able to satisfy consumer demand along its supply chain in a timely, flexible and comprehensive way.

The science industry and government have been proactive in addressing issues as they have arisen during the action agenda's development. Two surveys were conducted to gather current statistics and information on the industry. The industry made a number of submissions to government to advocate its interests and issues. It conducted several domestic and international promotional activities. The industry has been highly active in networking with industry colleagues and government to strengthen its internal and external linkages.

Vision for the science industry

The vision for the science industry is:

By 2015 Australia's science industry will be cohesive, export oriented and recognised world-wide for its quality, innovation and commercialisation of leading-edge technologies.

To fulfill this vision the industry will be:

- *Commercialising a much greater proportion of Australia's R&D;*
- *Exporting more than AU$3bn per year;*
- *Generating revenues of more than AU$5bn per year;*
- *Growing by an annual average of over 10%; and*
- *Attracting and retaining world-class scientists, engineers and commercialisers of laboratory technology and services.*

Definition of the industry

The science industry is defined as:

Research and development, design, production, sale and distribution of laboratory-related goods, services and intellectual capital used for measurement, analysis and diagnosis.

This definition creates a new conceptual arrangement of traditional industries.

Australia's science industry comprises researchers, manufacturers of scientific and laboratory-related goods, importer/distributors of scientific and laboratory-related goods, and companies offering a range of laboratory and technical services that involve *measurement, analysis and diagnosis.*

Science industry activities are primarily concerned with the testing of specimens *in vitro*[1].

Australia's science industry provides essential products and services to many other industries and science sectors such as agri-food, biotechnology, informatics, nanotechnology, pharmaceuticals, resources, environmental monitoring, manufacturing, medical and health care (including veterinary activities), testing laboratories, research and development and education.

Modern scientific equipment also draws on the technological innovations of a number of these industries. It makes extensive use of computers and information technology systems to analyse and report the results of analytical techniques.

[1] *In vitro* literally means, "in glass," i.e., in the artificial environment of a laboratory test tube, and outside a living organism; the opposite of *in vivo* (in a living organism).

Laboratory-related goods are scientific instruments, equipment and consumables.

`Scientific instruments and equipment include analysers, autoclaves, balances, baths, bio-separation equipment, cabinets, centrifuges, chromatographs, clinical diagnostics instruments, data loggers, detectors, extractors, filtration equipment, fume cupboards, furnaces, gauges, generators, hoods, incubators, laboratory automation software, laboratory robotics, life sciences instrumentation, liquid-handling equipment, measuring instruments, microscopes, ovens, pumps, sample collection equipment, spectrometers, vacuum equipment and general laboratory equipment.

Analytical instruments and devices measure a specific chemical, biological or physical attribute of a substance or product, and include spectrophotometers, chromatographs, laboratory analysers, water analysis systems, and mineral component analysis systems.

Within the subcategory of clinical diagnostics are instruments and specialist supplies such as blood and clinical chemistry analysers and related equipment.

Laboratory consumables used by the industry are products that are consumed in processes associated with the above equipment and include glassware, plastic ware, general laboratory ware, filtration consumables, general laboratory reagents and solvents, chemicals, and safety devices.

Laboratory and technical services use scientific equipment to provide measurement, analytical and diagnostic services.

Case study – Australian Proteome Analysis Facility

The **Australian Proteome Analysis Facility Ltd** (APAF), the birthplace of proteomics in Australia, is Australia's premier core proteomics facility. APAF was established in 1995 under the Australian Government's Major National Research Facility Scheme (MNRF).

Proteomics is the study and identification of the thousands of types of proteins found in humans, animals, plants, bacteria and other life forms. The expression of particular proteins can be used as 'biomarkers' of health, disease and assist in finding protein quality traits in agricultural crops.

APAF's four partner organisations - Macquarie University, University of New South Wales, University of Sydney and TGR Biosciences Pty Ltd (Adelaide) possess synergistic technologies and expertise. This enables the consortium to offer a far broader range of services to industry and researchers and provides maximum return on Australia's investment in this venture. APAF has received funding in the order of $45 million from MNRF and its four research partners.

APAF was the first dedicated proteome centre established in the world and continues to co-develop many of the laboratory 'tools' in use in proteomics research

worldwide. Australian researchers developed the concept of proteomics and APAF has remained at the forefront of technological development in this field ever since.

APAF engages a plethora of Australian and international science industry partners (around 350 in 2004) as a provider of proteomic R&D expertise, discovery partner, technology developer/licensor, technology educator, and market appraisal source. APAF has generated significant export dollars through royalties from products licensed to multinationals and overseas contracts.

APAF adds socio-economic value to Australia by cooperating with international and local pharmaceutical, biotechnology, agricultural and academic bodies to discover unique and specific markers of disease, agricultural quality and for product development. To this end, APAF collaborates with life sciences technology developers to keep Australia at the cutting-edge of proteomics research and development.

As a Major National Research Facility with a focus on service provision, APAF provides expertise in proteomics, functional proteomics and protein analysis, including the following services:

- Biomarker discovery
- Proteomics education & training
- 1 and 2-dimensional gel electrophoresis
- Image analysis
- Advanced mass spectrometry
- Protein and cluster of differentiation antibody arrays
- New MALDI biochip (Surface Tension Segmented) platforms
- N-terminal sequencing
- High-throughput G-protein-coupled receptor screening
- Bioactive screening technologies
- Metabolomics
- Amino acid analysis
- HPLC
- Bioinformatics
- Multiplex (luminex) assays
- Therapeutic protein production
- High abundance protein removal

Australia's science industry in the global context

The context

Measurement matters. People want to measure and quantify many things for many reasons, and there is a seemingly insatiable demand for greater quantification of physical, chemical and biological characteristics, for more accurate measurements, and more reliable measurements. Are our food, water and air contaminated, what are the contaminants, and what quantities are present? Have athletes been using performance enhancing substances? Are passengers and cargo safe to be transported? Are our health and medical tests accurate? Do manufacturing processes and products comply with specifications and standards to ensure that customer expectations are met?

Better measurement enables better-informed business and professional decisions that underpin production and sustainable economic growth which is essential to improvements in our quality of life which we have come to expect. The science industry provides scientific instruments, equipment and laboratory services that make the measurement of physical, chemical and biological characteristics possible.

Australia's science industry has globally recognised strengths in providing instruments and services that underpin many applications where highly accurate measurement of extremely low concentration levels and minute quantities is essential.

Production and markets

The science industry is a knowledge-intensive global industry that relies heavily on innovation and research intellectual property (IP) that can be commercialised to provide a continuous supply of high value-added world-competitive products, services and processes.

The global industry is integrated and trade reliant. Almost 50 percent of the global production of scientific equipment is traded internationally. Increasingly scientific services are being traded globally.

The global market for science-related goods in 2002/03 was estimated to be around AU$95 billion, and the market for science-related services is estimated to be at least as large as the market for science-related goods. The US is the largest producer and consumer of scientific equipment with around 50 percent of the market. The chief competitors of the US are EU and Japan, who together accounted for over 30 percent of global production and consumption. Germany is the largest export market in Europe and Japan is the largest market in Asia. The US imports mainly from Japan and Germany.

Australia's scientific equipment market was estimated to be $3 080 million in 2002/03, of which imports accounted for $2 820 million. Australian's scientific equipment manufacturers' domestic sales were around $260 million, and their exports were $670 million. Around 80 percent of Australian exports of science-related goods are purchased by the US, EU and North Asia. Employment was estimated to be about 8 000.

Australia's laboratory and technical service market was estimated to be $2 960 million in 2002/03, and exports were $110 million. Employment was estimated to be around 39 000.

Australia's publicly funded research organisations also provide significant services to the industry. In 2002/03, scientific research in Australia was valued at $3 077 million and employment was 22 500.

Some of the leading global science manufacturing companies are Abbott Diagnostics, Applera, Agilent Technologies, Beckman Coulter, Bio-Rad Laboratories, Eppendorf, Merck, Mettler Toledo, Perkin Elmer, Promega, Qaigen, Roche Diagnostics, Shimadzu Scientific Instruments, Thermo Electron Corporation, Waters Corporation and Varian. These companies have distribution outlets, service delivery operations, and in some instances, such as Varian and Thermo Electron, production facilities in Australia.

Australian science companies engaged in manufacturing include Ai Scientific, GBC Scientific Equipment Pty Ltd, Invetech Pty Ltd, Newport Scientific Pty Ltd, SGE International Pty Ltd and Vision BioSystems Ltd.

Significant Australian companies with international operations engaged in providing laboratory and technical services include Amdel Pty Ltd, Australian Laboratory Services Pty Ltd, Gribbles Group and Sonic Healthcare Ltd.

The unpredictable, but continuous changes, in technology require the makers of scientific instruments to be highly innovative. Restructuring, consolidation and mergers and acquisitions are key elements to long term growth in an increasingly competitive global marketplace. Global competition is constantly driving new standards of quality while demanding reduced manufacturing costs. The keys to success include the selling price, the performance capabilities of an instrument, state-of-the-art technology, technical support, and after-sales service.

To compete globally, the manufacturers of scientific instruments must be agile and be able to meet short product cycles. The competitive stance taken by companies can vary. Some companies produce a range of products, while others are specialised. To cope with the demand for continuous improvement the industry must have a range of products in the pipeline. They need to use state-of-the-art design technologies, rapid prototyping, rapid tooling and trialling technologies, data management and efficient usage and control of intellectual property. This competitive pressure is no less intense for laboratory and technical services companies – see case study on Australian Laboratory Services.

Case study – Vision BioSystems Ltd and the Victorian scientific instrument manufacturing cluster

Vision BioSystems Ltd, an Australian clinical diagnostics company, is a significant player in the AU$1 billion global market for clinical histological instruments and reagents. This market is growing at an annual rate of 8 percent.

Vision BioSystems has designed and manufactured state-of-the-art clinical histology instruments used for the microscopic examination of cells and tissue sections for over 20 years. It has built a reputation for innovation, reliability, safety and ease of use, particularly for the automated diagnosis of cancer. Vision BioSystems is a subsidiary of the publicly listed Vision Systems Limited, and is part of the Victorian cluster of scientific instrument manufacturers in Melbourne.

To build its global leadership in the rapidly growing clinical diagnostic market, Vision BioSystems' strategy has been to provide its customers with total system solutions. The solution includes the complete instrument and a continuous supply of consumables such as reagents used for tissue preparation and staining.

As part of this strategy, Vision BioSystems acquired the UK-based Novocastra Laboratories in 2002. Novocastra Laboratories is recognised globally for its range of advanced diagnostic instruments used for detecting the presence of specific proteins in cells or tissues. It is now the world-wide distributor for all Novocastra products.

Vision BioSystems' strategic R&D program recently produced several histology instrument platforms that increase laboratory productivity significantly. Notable amongst these instruments that have been successful launched are three to automate the staining of tissue samples and one that automates microscope slide handling for image processing systems.

Vision BioSystems has a dedicated customer support team to manage the needs of individual client, a high-quality cost-competitive contract instrument manufacturing service, and world's best practice manufacturing processes.

Being part of the Vision Systems group has enabled Vision BioSystems to draw on its resources to develop new products. One such resource is Invetech Pty Ltd, which is collocated with Vision BioSystems. The core business of Invetech is to design and develop integrated systems and advanced technologies for analysis and laboratory automation.

Market areas with strong prospects for growth are biomedical research and development; environmental monitoring and control; and homeland, commercial and personal security and surveillance. The food and beverage industries require capable equipment to ensure compliance with increasingly stringent regulations and for the development of better products. Education, agriculture, defence, oil and mining have a continuing and growing need for state-of-the-art scientific equipment and services.

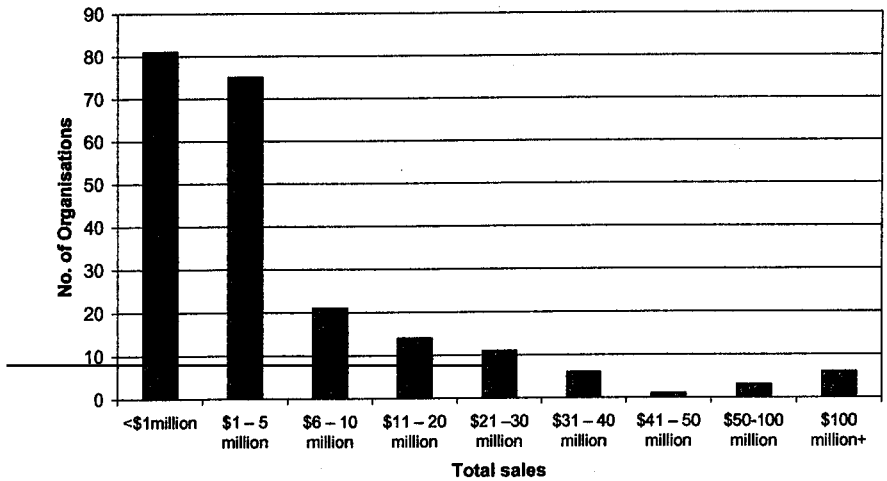
Technology areas that have strong long-term prospects are micro-fluidics and biosensors, array-based diagnostics, surface science, pathological detection and monitoring, image processing, genomic detection and bio-informatics. In Australia, collaborative research facility projects offer opportunities to develop leading edge products and services.

Structure of Australia's science industry

The survey of Australia's science industry by the Department of Industry, Tourism and Resources (DITR) in 2004 indicated that its structure reflects that of industry world-wide and Australia's industry in general – many small companies and few large companies. The survey indicated that the total value of turnovers from SMEs and from larger companies is approximately equal.

In Australia, over 75 percent of science companies have less than 10 employees. Over 95 percent of science companies have an annual turnover of less than $50 m (Figure 1). Recently, there has been a trend towards consolidation. Some larger laboratory and technical service companies have restructured and consolidated since 2001 and this continues. For example, SGS Group acquired the Australian company Scientific Services Ltd in 2001, and Gribbles Group Ltd acquired Amdel in 2002.

Figure 1: Structure of Australia's science industry



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Trade

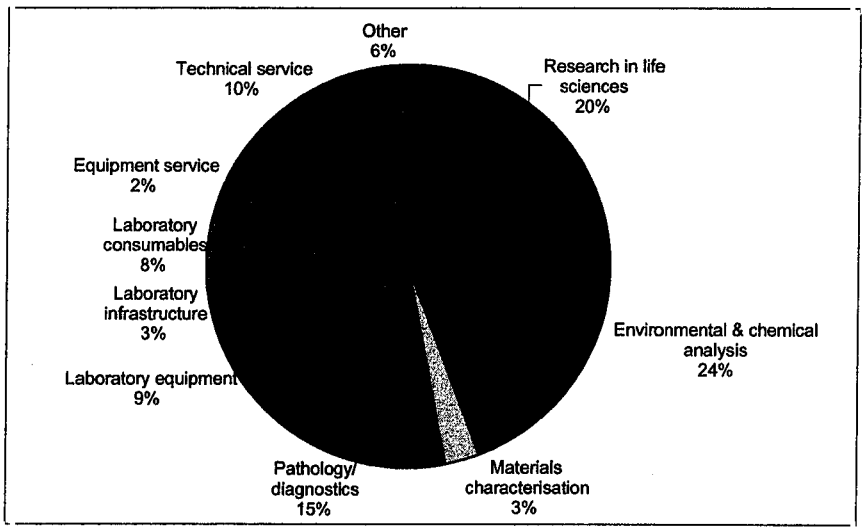
While barriers to international trade exist, initiatives such as the Information Technology Agreement of 2000 and Asia Pacific Economic Cooperation Fora's Early Voluntary Sectoral Liberalisation have reduced trade barriers significantly. There

are encouraging signs of these being reduced further in the medium term with Australia developing free trade agreements with US, and countries in Asia and South East Asia. With the internationalisation of the Australian economy some time ago, Australia's only impediment to free inwards trade of science industry products is the 3 percent customs duty on a limited range of imported business inputs. The industry is keen to see this 3 percent customs duty removed.

However, there are significant impediments to the global trade in services. These barriers are of a regulation and standards nature. Australian laboratory and technical services companies have found ways around these impediments and to be close to their customers by establishing operations in foreign countries.

Australian makers of scientific instruments and equipment are well integrated with the global economy. They have proven capacity to manufacture complex products in low-volumes at world-competitive prices. Their main products are for environmental and chemical analysis, research in life sciences and pathology/diagnostics (Figure 2).

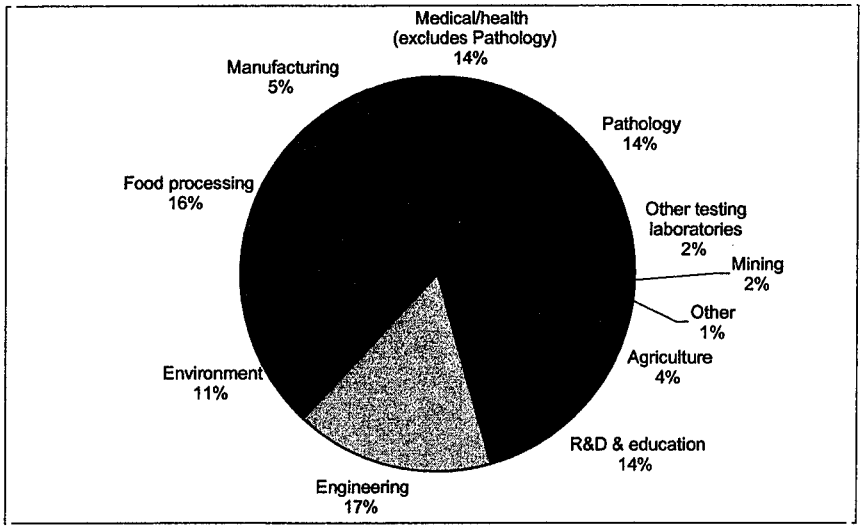
Figure 2: Products and services sold by Australia's science industry manufacturers



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

The 2004 DITR survey of the industry indicated that its main customers that use these instruments and equipment are engaged in engineering, food processing, medical and health, pathology, R&D and education (Figure 3).

Figure 3: Customers of Australia's science industry manufacturers

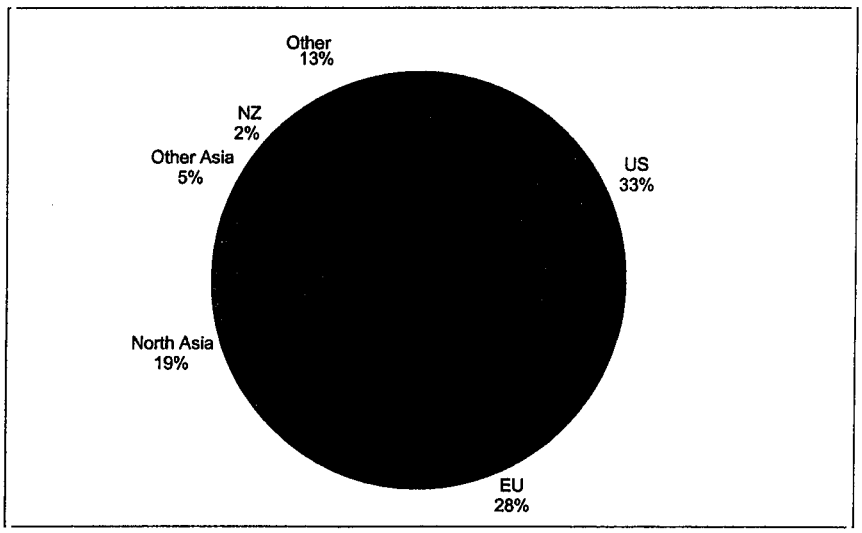


Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Australia's science industry is performing strongly in traditional markets and it is well positioned to take advantage of emerging market opportunities. The 2004 DITR survey indicated that the total value of exports from SMEs and from larger companies are approximately equal.

Australia's scientific equipment manufacturers are almost entirely reliant on exports for sales and market growth. This is due to the specialised nature of the equipment and the small size of the Australian market. Their high growth rates are coupled with strong export sales, and they expect this to continue. The main export markets are US, EU and Japan (Figure 4). These traditional markets and the emerging markets of China, South East Asia and South America present new opportunities for future growth.

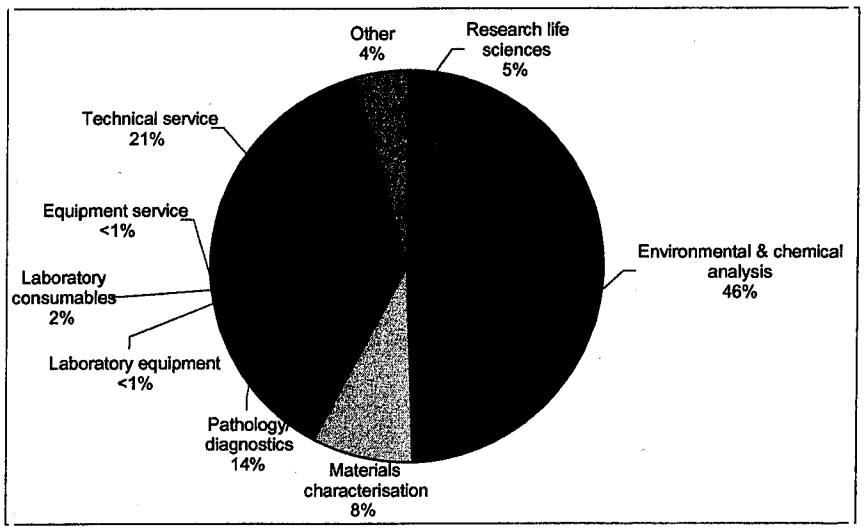
Figure 4: Main export markets of Australia's science industry manufacturers



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Australia's laboratory and technical services companies provide a range of laboratory-related services that involve measurement, analysis and diagnosis. Companies that provide product maintenance and service are also included in this industry segment. Science Industry Australia (SIA) estimates that Australia has some 10 000 laboratories involved in industrial, commercial and tertiary education activities. Of these activities, around 35 percent are industrial or commercial. The main types of services sold by laboratory and technical services companies are environmental and chemical analysis, technical services, and pathology/diagnostic services, and materials characterisation (Figure 5).

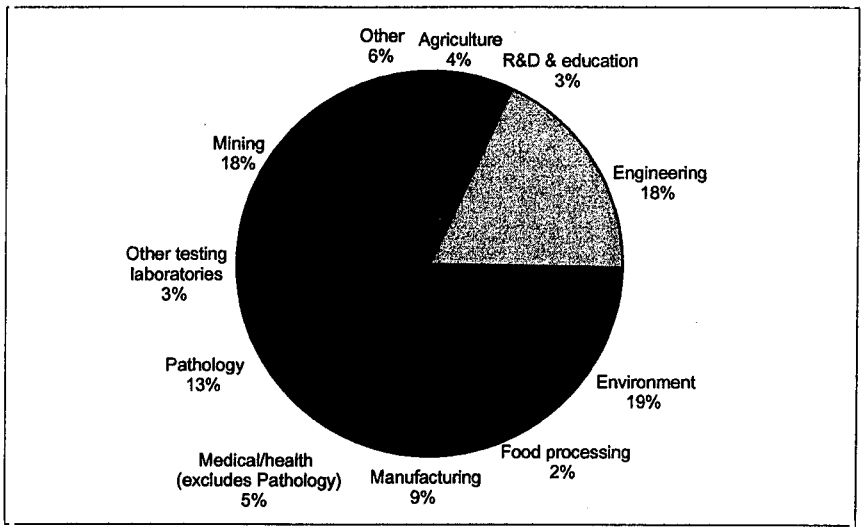
Figure 5: Types of services of laboratory and technical services companies



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

The main customers of laboratory and technical services companies are environment, engineering, mining and healthcare (pathology testing and medical/health) (Figure 6).

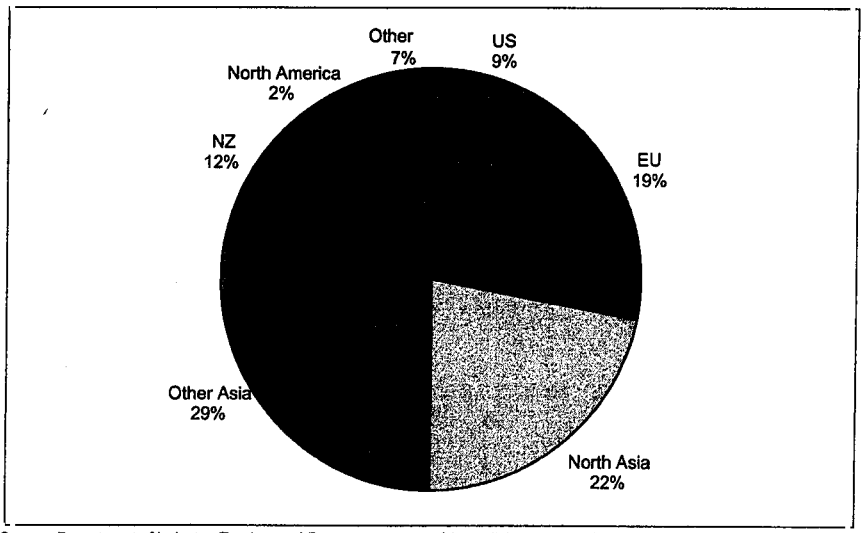
Figure 6: Customers of laboratory and technical services companies



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

While laboratory and technical services are traded largely domestically, there are encouraging signs of growth in exports. Having established themselves in Australia and New Zealand, Australia's leading laboratories are expanding their operations into Asia, EU and the Americas, as shown by the case study of a successful laboratory and technical services company, Australian Laboratory Services. Figure 7 shows the destination of exports of laboratory and technical services companies. 'North Asia', combined with 'Other Asia' now account for more than 50 percent of exports of laboratory and technical services.

Figure 7: Destination of the exports of laboratory and technical services companies



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Case study - Australian Laboratory Services

Australian Laboratory Services (ALS) is a diversified international analytical laboratory group with laboratories in 20 countries including Australia, North America (USA, Canada and Mexico), South America (Peru, Brazil, Bolivia, Ecuador, Chile and Argentina), Africa (South Africa and Tanzania), Europe (Sweden and Turkey) and Asia (Hong Kong, Singapore, China, Taiwan, Indonesia and Malaysia). After commencing operations in Brisbane in 1975, and joining with the Campbell Brothers Limited (market capitalization $400 million) in 1980, ALS has grown to be one of the largest analytical laboratory groups in the world with revenues in excess of $150 million in 2004. ALS employs 1700 staff globally, with over 750 of those being tertiary qualified.

ALS laboratories provide a broad range of sophisticated state-of-the-art services that help consulting and engineering companies, industry and governments to make better informed decisions. Their services include physical, inorganic, organic, bacteriological and toxicological analyses for mining and minerals exploration, environmental monitoring, equipment maintenance, commodity analysis and certification. ALS Environmental for example, can provide analytical information on more than 2 000 individual parameters to ultra low detection limits in a wide variety of sample types using a range of scientific equipment that includes:

- gas chromatograph mass spectrometers (GC-MS)
- high resolution gas chromatograph mass spectrometers (HRGC-MS)
- gas chromatographs (GC)
- liquid chromatograph mass spectrometers (LC-MS)
- liquid chromatographs (HPLC)
- inductively coupled plasma mass spectrometers (ICP-MS)
- inductively coupled plasma optical emission spectrophotometers (ICP-OES)
- atomic absorption spectrometers (AA)
- X-Ray fluorescence spectrophotometers (XRF)
- ion chromatographs (IC)
- infrared (IR)
- ultraviolet and visible spectrophotometers (UV/Vis)
- flow-injection analysers (FIA)
- a variety of automated instruments for titration, colour, BOD, and other tests

ALS has grown organically and by acquisition. Between 1999 and 2001 ALS acquired key minerals testing service companies in Canada. Its strong growth in this market niche has been on the back of the mining boom. Miners like to deal with reputable analysts, particularly for work as sensitive as testing mineral exploration prospects. ALS' micro contamination testing services complement Campbell Brothers' other activities of the specialist food hygiene division

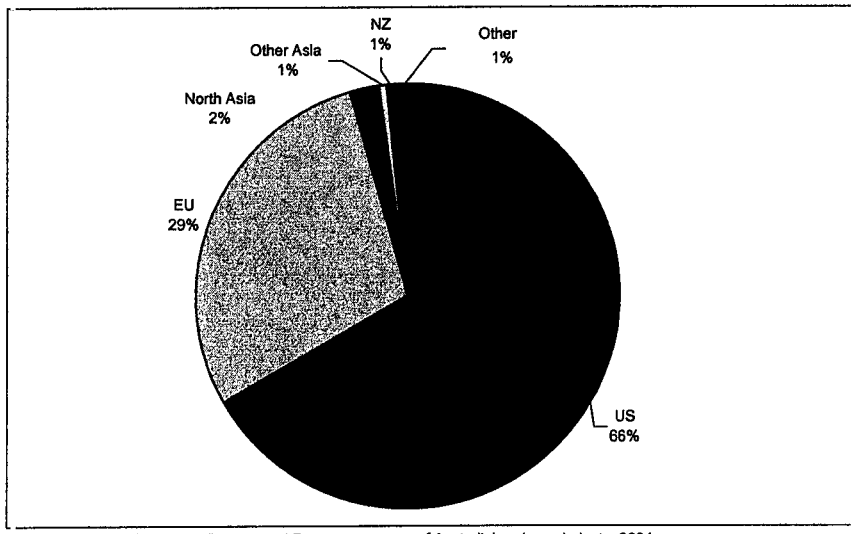
Cleantec, which cleans critical equipment such at breweries and supermarket freezers. ALS' latest start-up location is in Shanghai (China) where it is initially offering environmental and commodity testing services and plans to move into minerals work. New laboratories are also currently under development in Taiwan and South Africa.

ALS now has in excess of 20 percent of the global market for laboratory testing of minerals. This has enabled it to achieve the economies of scale so essential where high fixed costs have to be spread over many services to achieve sustainable profits which small laboratories find difficult. ALS sees the growth prospects for environmental testing and general analytical services as extensive. Driving this is stronger demand for these types of services as well as the outsourcing of laboratory services that were previously performed by companies in-house.

ALS' services are backed by a solid commitment to quality and customer service. Its quality systems are based on ISO 17025. Its analytical methods are the well-established internationally recognized procedures of US Environmental Protection Authority, the American Public Health Association, as well as regionally and locally prescribed methods and regulations.

Australia's science industry imports mainly from US and EU (Figure 8). The dominant global manufacturers are located in these countries.

Figure 8: Origin of imports for manufacturers



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Case study – SGE International Pty Ltd

SGE is one of the significant global suppliers of chromatography components used in chemical analysis. The technique of chromatography is used for environmental monitoring, food, petroleum, pharmaceutical, chemical industry, biotechnology and many other areas where materials have to be analysed for their molecular constituents.

SGE was founded in the early 1960s by Ern Dawes who was taught his craft of glass working as a technician in the glass shop at Melbourne University. While working at the ICI Central Research Laboratories in Melbourne he was involved in pioneering work on gas chromatography.

As a very capable technician, he was able to meet the needs of scientists working in chromatography and SGE was founded in the garage of his house in Sunshine in Melbourne's western suburbs. Starting with high precision microlitre capacity syringes, SGE has expanded across many areas of analytical chemistry through innovative design and development of new technologies. From the earliest stages it was clear that the Australian market was very limited and the first export sales were achieved from the garage operation.

The values driving SGE have always been a requirement to be the best in the world at the chosen field of ancillary equipment used in analytical chemistry and in particular for chromatography and mass spectroscopy. In addition to a commitment to good manufacturing practise there has always been a substantial commitment to product development. At times CSIRO assistance has been critical in helping SGE learn new technologies. Sometimes this assistance has been in the form of specific development projects and just as importantly at other times has been through informal advice. Through its strong values in product design, manufacturing and recruitment of the right people to the organisation, SGE has grown consistently over 40 years.

In addition to the SGE sales and distribution offices in the USA, UK, Germany, France, Italy, China, Japan, India and UAE there are in excess of 200 distributor partners throughout the world. All but three percent of SGE's production is exported. The proportion of sales to each market matches each market's proportion of the global GDP. The SGE group currently employs 350 people with the development and manufacturing operations located in Melbourne and Sydney.

Business environment

The 2004 DITR survey of the industry indicated that the quality of Australian labour, particularly at technical and management levels, was a significant advantage in Australia's business environment. This could be attributed to the highly educated

workforce. Linkages with publicly funded research organisations and the quality of their research were also important advantages in Australia, along with the availability of government programs to assist the industry.

Government R&D assistance measures are of particular interest to the science industry. The Australian science industry's key manufacturers were founded on the successful commercialisation of publicly funded research such as CSIRO experimental instrumentation – spectrophometers, gas chromatography columns, mass spectrometer detectors and more recently x-ray detection equipment. Australia's public sector research organisations have given rise to strategic clusters of companies and research organisations in Melbourne and Sydney that support the industry's continuing need for world-competitive products and processes. The case study on SGE International Pty Ltd shows how a successful science manufacturing company has developed from a strategic geographic cluster that facilitated knowledge transfer.

Underpinning this success are high levels of investment in R&D supported by a highly educated and skilled workforce.

R&D

The 2004 DITR survey of the industry indicated that science industry manufacturers spent on average 7.9 percent of sales on R&D in 2002/03. This was 10 times higher than the manufacturing industry's average. Such a level of investment by manufacturers in R&D was consistent with high performing manufacturers in Canada and UK. In comparison, laboratory and technical services companies spent on average 5.9 percent.

Education and skills

The 2004 DITR survey of the industry indicated that the level of educational attainment of staff in the science industry was high by industry standards. Almost 50 percent of staff in the industry had a bachelor degree or higher. R&D organisations in the industry had the highest qualified staff in the industry with 61 percent of staff who had a bachelor degree or higher (Figure 9). This compares with manufacturing industry's average of 13 percent of staff having a bachelor degree or higher.

Science companies spent on average expenditure five percent of sales on staff training. Manufacturers and product maintenance and service companies had the highest expenditure at eight percent of sales. Most of the training was through formal or informal on-the-job training.

The science industry like other parts of Australian industry is experiencing a shortage of skilled staff. Skills shortages existed in the areas of laboratory technicians, chemists, engineers (mechanical and software), and sales and

management with a high level of knowledge and understanding of science and scientific equipment.

The main disadvantages of Australia's business environment were the regulatory and certification processes and the availability of finance.

The industry has a strong export orientation and the acceptability of Australian standards in world markets is an advantage. However, the industry considered that the main factors impeding its export growth were high marketing costs, non-tariff and tariff barriers, and maintenance and after-sales service.

Figure 9: Education attainment of staff in the science industry

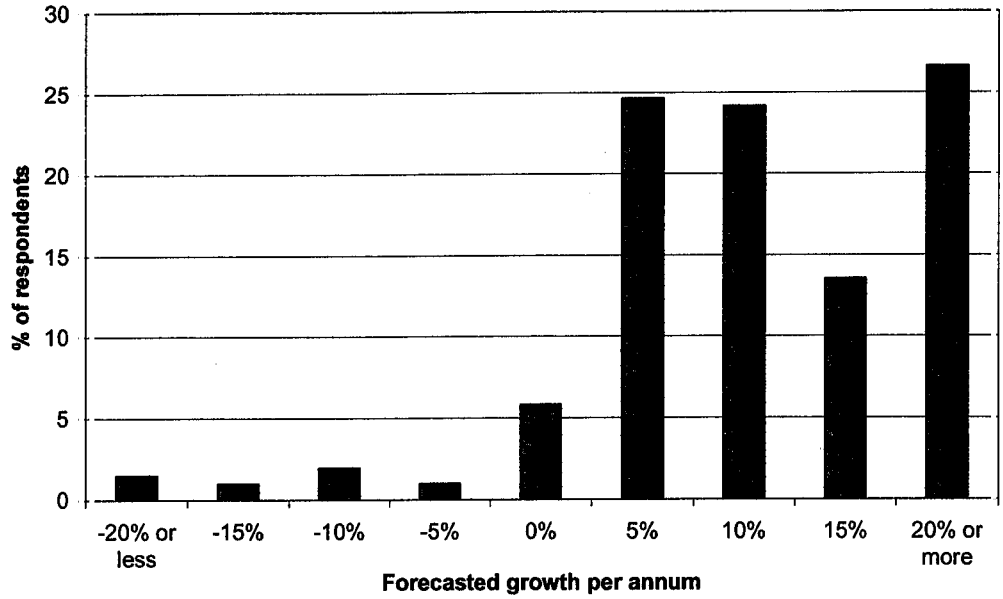
	Trade certificate	Diploma	Bachelor	Higher degree	No formal qualifications
All sectors	7%	12%	26%	22%	33%
Manufacturing	16%	8%	19%	5%	51%
Importer	8%	11%	38%	9%	34%
Maintenance	12%	19%	25%	11%	34%
Service provider	8%	20%	29%	8%	35%
R&D	4%	8%	24%	37%	27%
Other	0%	6%	25%	63%	6%

Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Future for Australia's science industry

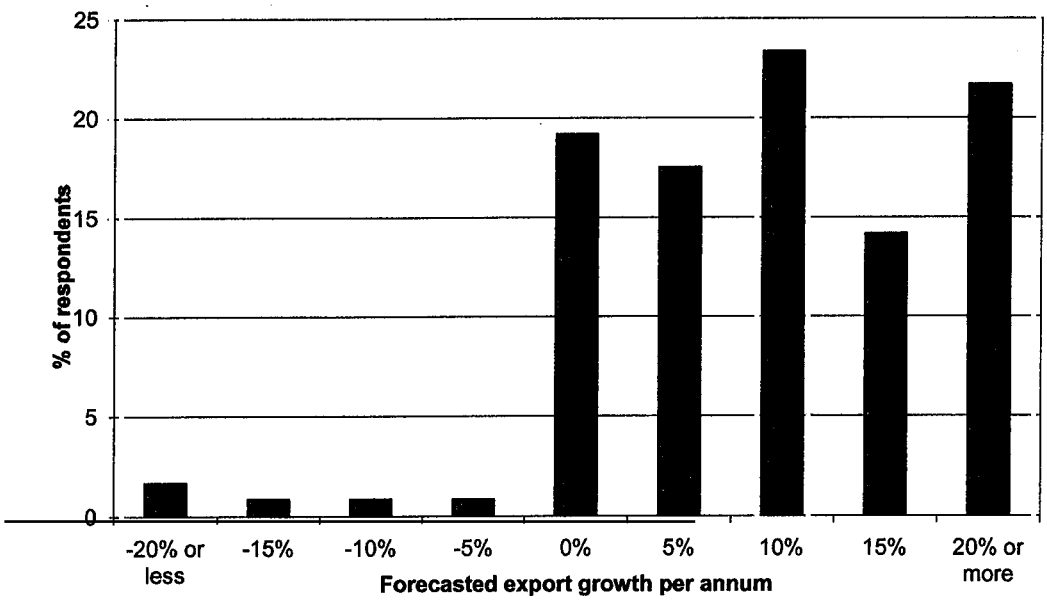
Australia's science industry is very optimistic about its future growth prospects. Over 60 percent of respondents to the DITR survey expected growth in excess of 10 percent per annum for the next three years. They were also optimistic about their export sales growth with nearly 60 percent of respondents expecting growth in excess of 10 percent per annum for the next three years (Figures 10 and 11).

Figure 10: Growth forecasts for Australian sales over the next three years



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

Figure 11: Growth forecasts for Australian export sales over the next three years



Source: Department of Industry, Tourism and Resources survey of Australia's science industry 2004.

The strengths, weaknesses, opportunities and threats facing Australia's science industry are illustrated in Figure 12.

Figure 12: SWOT analysis of Australia's science industry

Strengths

- Industry has experienced rapid growth (> 10% pa) in recent years and projects 10% pa growth in domestic and export sales over next 3 years.
- Highly innovative companies that have high investment in R&D – up to 8% of sales.
- Produces complex quality products in low-volumes at world competitive prices.
- Has a significant share of the world market for a number of products.
- Industry is highly export orientated:
- Larger science companies export more than 90% of their production; and
- The industry exports on average 74% of its manufacturing production.
- Acceptability of Australian standards in world markets.
- Highly skilled workforce.
- High investment in staff development – 5% of sales.
- Strong domestic market based on leading-edge life sciences research.

Weaknesses

- Industry is fragmented and has no coherent identity as the science industry.
- Industry is based on mature technologies and needs to find new 'products and services' to maintain high growth rates.
- Difficulty in accessing publicly-funded research IP for commercialisation of 'breakthrough' technologies that may provide new products and services.
- Due in part to poor communications between the stakeholders.
- Australia's complex regulatory regime with nine jurisdictions (Commonwealth + 8 states and territories) imposes high compliance costs on businesses.
- Low profile as a potential employer.
- Skills shortages of laboratory technicians, chemists, mechanical and software engineers, sales and management.
- Researchers lack knowledge and skills in the commercialisation of their research.
- Entrepreneurial skills of company leaders & managers.
- Training and experience in quality management.
- Lack of attractiveness of science industry projects to venture capital for expansion.
- Science industry's lack of awareness and use of assistance available from governments and industry.

Opportunities

- Strong and growing demand for science products and services in certain close overseas markets, eg. China, Japan, Taiwan, Singapore, Malaysia, and emerging markets in South America.
- Clusters in Victoria (around Clayton and Monash University) and NSW (around North Ryde) could be used to develop new technologies and new companies.
- 'First mover' advantages in bringing new products and services to market.
- Australia's strong public sector research and opportunities for the effective transfer of intellectual property, skills and know-how to industry for its commercialisation.
- To establish and maintain effective linkages between Australia's excellent public research capabilities and industry as a source for new product and service development.
- To build alliances with support organisations such as Knowledge Commercialisation Australasia; Australian Institute of Commercialisation; industry associations e.g. PACIA and AiGroup (with its InnovationXchange).
- Close to and in the same time zone of significant markets in Japan and the emerging market of China.
- Exploit the existing distribution channels of Australian subsidiaries of MNCs.
- Strengthen the linkages between companies and strengthen the industry association.

Threats

- Regulatory barriers in overseas markets.
- High value of A$ has negative impact on exporters' profitability and company viability.
- China's emergence as a manufacturer of high volume and low cost scientific equipment in the future.
- Failure to develop new technologies leads to loss of international competitiveness
- Ageing of the workforce and difficulty in attracting replacements.

Issues, recommendations and strategies

Developing the action agenda

The decision to develop the Science Industry Action Agenda recognises the importance of the science industry as a key enabling industry that underpins Australia's future economic growth.

In 2003 Science Industry Australia Inc. (SIA) made application to the Government for an action agenda to assist it to realise opportunities and overcome impediments to the industry's growth. The proposal was influenced in part by SIA's involvement in a similar process with the Victorian Government in 2002 to develop a strategic plan for the industry in Victoria. Australia's science industry is a national industry and draws on expertise and markets across Australia and the world. SIA recognised the need for the industry's strategic plan to have a national focus.

On 26 February 2004 the Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane and the then Minister for Science, the Hon Peter McGauran, jointly announced the Science Industry Action Agenda in partnership with the industry.

Industry, researchers and government worked together to develop the action agenda by identifying initiatives that would overcome the impediments to the industry realising its full potential. The strategic priorities for the action agenda are uniting the industry and improving its internal and external linkages, commercialising more Australian scientific innovation, growing exports, and improving the industry's workforce. These priorities and resulting strategies and actions resonate with the Government's *Backing Australia's Abilities* initiatives.

The Strategic Industry Leaders Group (SILG) that led the development of the action agenda was drawn from stakeholders in this diverse industry's value chain. Four working groups of highly experienced and qualified people from the industry and research communities supported the SILG. They focused their activities on market development; commercialisation of research; supply chains; and education, training and work practices.

The SILG met six times and the working groups met five times to develop the action agenda in slightly more than 12 months. During the development of the action agenda, action was initiated on a number of issues that arose and had implications for the industry's performance. The action agenda made a number of submissions and approaches to government providing advice and suggestions on policy settings. It showcased the industry at international and domestic events and commenced a public discussion series on improving the transfer of technology and the intellectual property of public sector research. It also conducted a survey of the industry to gather current key economic information with which to inform stakeholders in their consideration of policy settings.

CAPTURING AND COMMERCIALISING MORE INTELLECTUAL PROPERTY

"In terms of access to information as a driver for business innovation, nothing equals the advantages gained from face to face interaction and business networking"

R&D Commercialisation Working Group of the Science Industry Action Agenda, 2004.

The science industry is a knowledge-intensive global industry that relies heavily on intellectual property to provide the feedstock for a continuous supply of innovative high value-added world-competitive products, services and processes.

To enable this, the science industry spends significantly more on R&D as a percentage of sales than manufacturing industry as a whole. In 2002-03, science industry manufacturers spent eight percent of sales on R&D, while laboratory and technical services providers spent six percent. In contrast, Australia's manufacturing industry on average spends less than one percent of sales on R&D. Patents are held mainly by research organisations and science industry manufacturers.

The industry is seeking to increase significantly the economic and social return from Australian public sector research. Greater commercialisation of Australia's publicly-funded research by the science industry will contribute to improving Australia's innovation and investment outcomes.

To improve innovation outcomes, the implementation group's initiatives will be aimed at aligning publicly funded research more closely with the industry's needs, improving communication and understanding between the industry and researchers, and raising the industry's awareness and use of the available support measures.

To improve investment outcomes, the implementation group's strategy will be aimed at improving the entrepreneurial skills of the industry's leaders and managers, and enabling SMEs to gain greater access to finance, particularly venture finance, to fund innovative product and service development and production.

Impediments to commercialisation of research intellectual property

The science industry identified the main institutional impediments to the effective development and commercialisation of research intellectual property as:

- Poor alignment of public research with science industry needs, and poor interaction between the industry and researchers;
- Costs of transferring intellectual property from researchers to industry; and
- Eligibility requirements of some Government R&D support programs that exclude larger science companies.

The main impediments within the industry are:

- Lack of awareness and use of the many support measures available from governments and industry bodies for R&D; and
- Failure to attract venture finance.

Improving the alignment of public research with market needs, and communication between the industry and researchers

As much as 10 to 20 percent of Australia's $4 billion annual budget for public sector research could be expended on scientific equipment for measurement, and there is strong vendor involvement in the tendering process. But this does not flow over into a closer alignment between researchers and industry in terms of the development of new diagnostic techniques.

The science industry was concerned that public sector research was not sufficiently aligned with market needs. Scientific instrument manufacturers are mainly interested in research intellectual property from CSIRO, and therapeutic diagnostics manufacturers are mainly interested in the intellectual property from medical research organisations.

The science industry indicated that the relationship between public sector organisations and companies in the industry has become more complex in recent years. This in part has been brought about by research organisations increasingly seeking greater returns on their intellectual property. As these returns may be realised by the research organisations forming spin-off companies, rather than through external licensing, established Australian companies have less opportunity to commercialise the intellectual property from these organisations. A consequence of this is that some of Australia's science companies find it more cost-effective to obtain intellectual property from foreign rather than from Australian sources.

Government has a number of programs to encourage cooperation and collaboration among Australia's publicly funded research organisations and between those organisations and private sector investors and industry, and it is investigating other ways to improve this collaboration.

In October 2004, the Department of Education, Science and Training's (DEST) released the National Survey of Research Commercialisation within Australia's publicly funded research establishments. The survey results show that the number of income-yielding patent licences held by Australia's publicly funded research organisations increased from 476 in 2000 to 585 in 2002, as have the number of start-up companies resulting from patent licenses and the overall value of those organisations' equity holdings have also increased. The number of new inventions disclosed had also grown.

Income from licensing for 2002 was less than two percent of total research expenditure. By comparison, the equivalent figure in the United States, where the commercialisation of university research is highly developed, is around 3.5 percent.

Within the specific research sectors, universities earned about 59 percent of total licence income in 2002. In comparison, the medical research institutes earned

around 22 percent of licence income, CSIRO (13 percent), CRCs (5 percent) and other publicly funded research organisations (1 percent).

Case study – Rapid instrument development for Australia's wine industry

The Australian wine industry's rapid growth during the past decade is well documented with continued success in the export markets of the US, UK and Asia. Currently, wine is Australia's fifth largest rural export.

Driving this growth is the ability of Australian wine producers to deliver a quality product at a competitive price. While increased competition both internationally and locally looms large, technology is enabling Australian grape growers and winemakers to deliver quality wine grapes consistently with minimal inputs of water and chemicals.

The techniques for measuring grape quality using sugar content, pH and acidity are straightforward and can be done quickly and efficiently. However, the current technique for measuring the colour of red grapes, another vital indicator of potential quality, is slow and requires skilled technical staff. Finding a quick, reliable, accurate and cheap technique to enable Australia's hundreds of small wineries to measure red grape colour has proven challenging.

The first step to solving this challenge was to find a suitable technology. Research by the Cooperative Research Centre for Viticulture (CRCV) showed that near-infrared (NIR) spectroscopy offered the best potential for measuring the colour in the skins of red grapes using total anthocyanins as the indicator. To ensure the instrument yielded accurate results CRCV calibrated it against thousands of grape samples. This technology has been adopted by many of Australia's large wine producers and commercial laboratories.

The next step was to develop a cheaper, portable version of the instrument.

CRCV, in collaboration with the Sydney-based company, Integrated Spectronics, are currently developing a prototype of a portable instrument for measuring colour, pH and total soluble solids in red wine grapes. The instrument will be designed for use at the vineyard, the weighbridge and the winery, enabling the industry to monitor grape quality more closely and rapidly at each stage in the logistic chain. Integrated Spectronics is providing expertise in developing the hardware and systems for operating the equipment. The CRCV is developing the calibration, software and a sampling technique that will make it as easy as possible for the end users while providing quality data.

The prototype is expected to be completed in mid-2005, with testing to commence in the latter half of the 2005. The commercial product is expected to be ready in 2006.

Anecdotal evidence from the industry indicates that interactions between researchers and companies can be complex and frustrating to both parties. As one company commented:

"Our experience is that the majority of researchers are not genuinely interested in cooperation with commercial operations. The exceptions have been very successful".

On the other hand, when research organisations have approached science industry companies to offer their intellectual property the companies have said that none of the intellectual property was close enough to their portfolio interests, or that the intellectual property was not sufficiently developed to be of interest.

There is a clear need to improve industry and researcher mutual understanding of one another. The strategy proposed to address this situation aims to increase and systematise the intensity of interactions between companies and researchers. Specific measures include:

- Developing and implementing an exchange program between public sector research organisations like CSIRO and the science industry to enable researchers and industry to understand each others needs and objectives.
- Instigating meetings between companies, universities and research organisations in the same region to establish relationships and exploring potential for collaboration, such as investigating opportunities to work on projects that could attract funding through the Australian Research Council Linkage grants program.
- Encouraging companies seeking intellectual property to work with public sector researchers and other stakeholders like industry representative bodies and intermediary organisations to resolve issues surrounding the transfer of intellectual property.
- Taking forward to Government the findings from SIA's 2005 symposium series on technology diffusion from publicly funded research organisations to industry.

A number of industry organisations provide intermediary services for Australian universities and publicly funded research organisations that facilitate the successful commercialisation of research. The organisations include Knowledge Commercialisation Australasia, and Australian Institute for Commercialisation Limited. The industry is developing strategic alliances with these organisations to achieve mutual objectives.

Government has several measures aimed at improving the commercial outcomes of publicly-funded research under its *Backing Australia's Abilities* initiative that offer opportunities for industry involvement. These include the National Research Priorities, Cooperative Research Centres program, and the new Industry Cooperative Innovation Program. Opportunities may also arise through collaborative research facilities projects like the Synchrotron and the Square Kilometre Array radio telescope.

During the development of this action agenda the industry was made aware of these programs. The action agenda's implementation group will explore opportunities for the industry's involvement in these initiatives.

Reducing the cost of transferring IP from researchers to industry

The science industry was concerned at the high cost of establishing legal arrangements with research organisations for the transfer of their IP to industry.

CSIRO has been addressing this issue by introducing standardised procedures and short proforma agreements to enable large companies and SMEs to use its consulting and research services. However, more complex interactions will, by their very nature, incur higher costs.

There is evidence that publicly funded research organisations and universities are investing in the commercialisation process. In 2002, the 124 research organisations that responded to the National Survey of Research Commercialisation stated that they employed around 500 full-time equivalent commercialisation staff. Also, 45 organisations reported that they had increased their employment in commercialisation staff by 40 percent for each of the three survey years between 2000 and 2002.

Eligibility for Government R&D support programs

The larger science industry companies argued that R&D grant and concession programs do not provide sufficient incentive for them to invest in R&D. They are ineligible for certain grant programs that have a $50 million turnover limit. These companies argued that such a limit was unrealistic in a global context where other countries such as US had a higher threshold for their R&D support measures. The industry considered that $200 million was a more realistic limit. The industry noted however, that most companies in the industry are SMEs who can access Australian Government programs.

These larger companies can access the R&D Tax Concession programs. However, they argued that these concession programs did not provide sufficient incentive for R&D investment.

The industry noted that the foreign parent companies of their Australian subsidiaries provided R&D support to their subsidiaries. However, the parent placed limits on its global R&D investments, and the subsidiaries had to compete with one another for these investment funds. The foreign parent may also impose a limit on the R&D investment of its subsidiaries.

Case study – Intellection and QEMSCAN

QEMSCAN is a new and highly innovative mineral analysis technology that is a prominent example of the successful commercialisation of CSIRO research. It combines x-ray detection equipment with sophisticated software to rapidly identify and analyse the different minerals in ore samples and process streams, improving the efficiency and profitability of mining and minerals processing operations. Intellection, a CSIRO spin-off company, is commercialising and licensing the technology to some of the world's mining giants. It is built on more than 20-year of rigorous scientific research and development by CSIRO in Brisbane.

By automatically analysing and characterising minerals 10 000 times faster and more accurately than traditional methods, QEMSCAN provides higher quality information that enables better commercial decision-making and problem solving.

Comprising a scanning electron microscope, four x-ray detectors and a software package, QEMSCAN is the fastest and most accurate particle analysis and quantification tool currently available. It eliminates the error-prone traditional method of a technician peering through an optical microscope to identify, quantify and estimate the composition of ore samples. QEMSCAN is also finding application in characterising minerals that reduce the efficiency of coal-fired power stations.

Global minerals companies such as Anglo Platinum (South Africa) BHP Billiton (South Africa), CVRD (Brazil), Falconbridge Noranda (Canada), Phelps Dodge (US), Rio Tinto (Australia) and SGS Lakefield have been using QEMSCAN for many years. A typical QEMSCAN system costs around $1 million, and these companies are achieving paybacks within a matter of months. Recognising the value that QEMSCAN offers, Phelps Dodge, the world's second largest producer of copper, and Anglo Platinum each purchased three systems in a three year period.

Intellection is aiming to be a global leader in the automation of the quantitative evaluation of minerals. It has developed a reputation of technology leadership and expertise which has allowed the company to develop a successful global business and valuable commercial connections.

Intellection has built strong relationships with its user companies by providing the highest standards of after-sales service. In 2003, this enabled it to partner with Phelps Dodge, Anglo Platinum and other 'power users' in a $500 000 program to accelerate the development of QEMSCAN's software. This improved QEMSCAN's user-friendliness by simplifying the time and effort needed to conduct analyses. In the future, Intellection will provide integrated systems support, consulting and testing services.

Technology such as QEMSCAN demonstrates CSIRO's excellent record of conducting world-class research ranging from basic to more commercially oriented research. The knowledge generated from such research has social and economic benefits, and reinforces Australia's reputation as a world leader in scientific research.

Industry's awareness and use of support measures

The science industry's awareness and uptake of the available R&D assistance measures from Commonwealth, State and Territory governments could be improved. Encouraging companies to access appropriate existing programs is a priority of the action agenda.

Venture capital

In common with other industries, science industry SMEs in particular, had difficulties in attracting venture finance to their investment projects.

To demonstrate these difficulties, the Australian Bureau of Statistics' 2003-04 survey of venture capital in Australia identified that only a small percentage of proposals for venture capital financing were successful - 137 venture capital managers reviewed 10 570 investment proposals, conducted further investigation on 1 067 of these and invested in 181. It should be noted that a high attrition rate such as this is a feature of the venture capital industry globally.

While the high attrition rate could be due to many factors, the implementation group will develop measures to assist science companies to improve their venture capital proposals to enhance their prospects of success.

The Government has measures in place to develop Australia's venture capital industry. Pooled Development Funds offer development capital to SMEs. The Innovation Investment Fund and Pre-Seed Funds are aimed at stimulating Australia's venture capital industry. The Commercialising Emerging Technologies (COMET) Program aims to enhance small new start-up company commercialisation prospects by supporting activities such as business planning and management skills development. The Venture Capital Limited Partnership initiative aims to improve Australia's attractiveness as a location for venture capital investment.

In developing strategies to improve the IP commercialisation outcomes for the science industry it is important not to duplicate the work of intermediary organisations already mentioned, Australian Venture Capital Association Limited, or existing government measures. As part of the implementation of this action agenda, the science industry will improve the awareness and uptake of existing support measures aimed at improving their access to venture finance. The science industry will also research and recommend changes to existing measures to enhance their effectiveness.

Recommendation 1

Increase significantly the science industry's commercialisation of intellectual property, particularly from publicly funded research.

GROWING SCIENCE INDUSTRY EXPORTS

The companies that survive longest are the one's that work out what they uniquely can give to the world not just growth or money but their excellence, their respect for others, or their ability to make people happy.

Charles Handy

Australia's science industry is globally competitive. It is performing very well with strong growth in the domestic market and exports in its main markets of environmental and chemical analysis, life sciences research and pathology. The industry has a strong future. Business confidence is very high with about 60 percent of the industry expecting growth of at least 10 percent per annum over the next three years. In some instances, Australian companies have significant shares of the global market in scientific instruments, suggesting that Australia has a strong global competitive advantage for those instruments.

These manufacturers rely on global markets because of the highly specialised nature of their products, their high value and the limited size of Australia's market. Products include spectrometers, spectrophotometers, chromatographs, blood analysing instruments and therapeutic diagnostics for testing blood and tissue.

While laboratory and technical services are mainly sold into the domestic market, laboratory and technical services companies are expanding into export markets mainly in Asia, although they also have a presence in the Americas and Europe.

The industry's markets are geographic as well as the global supply chains of multinational companies (MNCs). Australia's larger science companies sell into both these types of markets as they are either subsidiaries of MNCs such as Varian, Thermo Electron Corporation and Merck, or Australian MNCs in their own right such as SGE, GBC, Australian Laboratory Services, Gribbles and Sonic Healthcare.

Opportunities exist for import/distribution companies and the subsidiaries of MNCs to notice international opportunities and to commence to manufacture and export by using the distribution networks of their parent company.

The traditional geographic export markets in US and EU are hardest to enter due mainly to non-tariff barriers. Product certification to CE Mark, UL certification and US Food and Drug Administration standards is the main issue for manufacturers. Once a company has a presence in these markets it tends to remain. Laboratory and technical services companies are also faced with regulation and standards barriers. Their laboratories comply with the globally recognised regulations and standards as well as the local ones required by individual countries.