The Secretary

Standing Committee on Science and Innovation

House of Representatives

Parliament House

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Submission No. 61

SCIENCE INDUSTRY ACTION AGENDA

Submission to

House of Representatives Standing Committee on Science and Innovation on

Marketing our Innovations

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28 April 2005

Introduction

Science Industry Australia Inc. is pleased to present the House of Representatives Standing Committee on Science and Innovation with its submission to the inquiry into pathways to technological innovation.

In March 2005, the House of Representatives Standing Committee on Science and Innovation called for submissions detailing successful case studies of Australian technological innovations. The Committee also sought submissions on issues such as:

- Pathways to commercialisation;
- Intellectual property and patents;
- Skills and business knowledge;
- Capital and risk investment;
- Business and scientific regulatory issues;
- Research and market linkages;
- Factors determining success; and
- Strategies in other countries that may be of instruction to Australia.

Background

The Australian science industry, in collaboration with the Department of Industry, Tourism and Resources (DITR) and the Department of Education Science and Training (DEST), has developed a strategic plan for the industry under the auspices of the Commonwealth's Action Agenda initiative (Science Industry Action Agenda). The action agenda process is aimed at identifying impediments to the industry's growth and defining and implementing long-term strategies to overcome these impediments.

Much of Australia's science industry has grown from Australia's world-renowned publicly funded research institutions. The future of this knowledge-intensive industry relies on a continuing supply of innovative, globally-competitive products, processes and services. Consequently, the primary focus of the action agenda is to continue the strong growth of the industry by commercialising a significantly greater proportion of high quality Australian research.

Australia's science 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 of physical, chemical and biological phenomena.

Australia's domestic market for science industry products and laboratory related services was estimated to be $6 billion in 2002/03. Of this, imports were $2.8 billion and domestic sales were $3.2 billion. Exports of science industry products and services in the same period accounted for an estimated $780 million. Employment was approximately 47 000. In addition, scientific research within Australia was valued at around $3 billion with an estimated employment of 22 500.

The industry's products and services enable the measurement of very low concentrations of substances and identify microscopic components present in minute quantities of matter. Many industries and government use the information so provided to make better informed business and professional decisions, ensuring the quality of our food, water, air, environment and health, thereby enhancing the quality of life.

This industry is outperforming most others in terms of its commitment to innovation and exporting. The industry's manufacturers invest eight percent of their total annual sales in research and development, which is ten times higher than the manufacturing industry's average. This, along with its highly skilled workforce, underpin the industy's average annual growth rate of 10 percent. This growth rate is more than twice the national average. The industry is optimistic about its future, and expects this growth rate to continue over the medium term.

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, bio-informatics and homeland security. In Australia's, collaborative research facility projects offer opportunities to develop leading-edge products and services.

Australia's science industry is well integrated with global markets, and its larger companies export up to 90 percent of their production. The principal overseas destinations for its products are US, EU and Japan, while laboratory and technical service companies export mainly to Asia, EU and the Americas. These traditional markets and the emerging markets of China, South East Asia and South America present new opportunities for future growth.

Industry issues

Support for small and medium sized enterprises – the views of a small manufacturer of scientific instruments

Introduction

High technology businesses are different from many other business enterprises. They need to grow rapidly to meet the demands of rapid changes in technology and markets, and growth rates of 20 percent or more per annum are common. Consequently, high technology businesses need to invest continuously in product development. This places strains on them during the early stages of their development, and the availability of investment capital is a primary determinant of the rate at which high technology businesses can grow.

Small enterprises with turnovers of between $1 million and $5 million can find it difficult to generate sufficient profit to fund the commercialisation process properly. Even by returning all profit to the business to fund investment, small enterprises will find it difficult to grow beyond annual revenues of $2 million to $3 million.

A useful framework for identifying the potential gaps between the government assistance measures available and what small enterprises in the industry require is the process for developing and commercialising high technology products. The stages in this process are:

a) Basic research into a phenomena;

b) Prototype or "proof of principle" prototype development;

c) Working prototype development;

d) Production unit development;

e) Initial marketing and technology education (transfer to the market place);

f) Initial production runs;

g) Product refinement and improvements; and

h) Full commercialisation – marketing, sales and distribution.

Stages a) to c): Basic research to prototype development.

These stages are reasonably well catered for by government. Research grants are available from organisations such as the Grains Research and Development Corporation, Australian Research Council, and Meat Research Corporation. The Commonwealth's new Commercial Ready Program supports product commercialisation from R&D, through proof-of-concept, to early stage commercialisation. The new Industry Collaborative Innovation Program (ICIP) supports cooperative projects between small and medium sized enterprises (SMEs) and research organisations. Some state governments provide assistance to the various stages of technology development. In 2004, the Science Industry Action Agenda provided its suggestions for the design of Commercial Ready and ICIP during the industry consultation phases of these new programs. Many of the suggestions made by the SIAA appeared in the final sets of guidelines.

Stages d) to f): Production unit development to initial production runs.

The Commercial Ready Program provides assistance for SMEs to take technology or products from prototype to early production. However, Commercial Ready is a competitive grants program. In the event that an SME is unsuccessful in its application, the entrepreneur would have to finance these stages either from the SME's profits or from personal loans. The cost of financing production during the early years following the introduction of a product into the market can generally be provided by the entrepreneur. In many instances personal loans from sources such as family and lending institutions are necessary to provide finance beyond these stages of the product realisation phase. The experience of many SME's in the science industry is that there is limited venture finance available to them from the market for these development stages.

Stage g): Product refinement and improvement.

Once firms move into the product refinement and improvement phases, the benefits are directly accruable to the firm and so the case for any form of government assistance is diminished. Also in this phase Australia's obligations as a member of the World Trade Organisation, places restrictions on federal or state governments to provide such funding.

Stage h): Full commercialization – marketing, sales and distribution.

The EMDG Scheme and the R&D Tax Concession program provide SMEs with assistance for certain aspects of developing export markets and ongoing product improvements.

The EMDG Scheme allows SMEs to claim a 50 percent refund for expenditure on export marketing above $15 000. The science industry considers that the EMDG Scheme to be very useful, and in its submission to Austrade's review of the scheme the Science Industry Action Agenda made suggestions on how the scheme could be improved.

The R&D Tax Concession program allows SMEs to claim a 125 percent tax deduction for eligible expenditure. It requires the SME to spend the money first and then claim the concession. The industry's comments on the scheme are expressed later in this submission.

Sources of market finance

External investment is necessary for high technology SMEs to sustain growth rates of more than 20 percent per annum that are necessary to meet market demand and remain competitive and viable. However in Australia, the sources of external investment are limited to venture capital, business angels and financial institutions. The amount of capital available from each option is also limited.

This view from industry is also supported by survey work conducted by DITR in 2003. The survey showed that there is a perceived funding gap for early stage commercialisation, by both investors and start-up firms, although there is no consensus on the exact range of the gap. The most common assertion is that there is a funding gap in the range of $250,000 - $1 million, and possibly extending to $2 million – which is often the range of funding needed at the research commercialisation (pre-seed) stage.

There is some evidence, however, that the extent of the 'funding gap' is inflated. It is reasonable to expect firms that do not receive funding to blame the lack of capital without realising it may be the comparative poor investment opportunity of their proposal. Evidence of this perspective is seen in the different reasons for not investing offered by investors and firms seeking finance (*Capital Availability, Views of COMET companies* (Survey completed by ITR in 2003)). Investors most frequently quoted poor business plan and lack of management experience as the key reasons whereas firms attributed it to the risk of the proposal, an unproven product or an untested market. It is likely all these reasons would compound in the university environment when seeking to obtain funding for commercialisation.

The Science Industry Action Agenda (SIAA) identified that the quality of investment proposals from SMEs was an impediment to them accessing adequate finance. The SIAA will address this impediment during its implementation.

Venture capital

Venture capital companies (VCCs) are primarily interested in SMEs that can offer technologies capable of achieving revenues $50 million to $100 million over five years. Consequently, the VCCs tend to favour specific industries, such as biotechnology, medical instruments, information technology and telecommunications. VCCs consider that other industries and technologies that are less well known to the market have a higher risk profile. They also consider that other industries and technologies provide fewer opportunities for the VCC to exit from the venture without a greater loss than the better known industries and technologies. Furthermore, VCCs tend to target investments in the range of $5 million to $20 million. However, often SMEs require smaller investments in the range of $1 million to $2 million. Thus there is a mismatch between what VCCs wish to provide and what SMEs actually need.

The Commonwealth's Pooled Development Fund (PDF) has helped to establish several VCCs, but the program does not provide finance directly to SMEs. Nor does the PDF program set guidelines on how VCCs should decide to fund potential investments. This commercial decision is left to the VCCs.

Business angels

Business angels can offer SMEs both investment funding and management expertise. However in Australia, there are very few business angels, and it is often difficult to achieve a suitable match between the angel and the SME. Nonetheless, business angels are a much better source of investment funding than VCCs. Business angels look for investments of less than $2 million, and they expect less equity in the business than VCCs. Also, the exit strategy of a business angel can be more beneficial to an SME than that of a VCC as business angels tend to allow the SME entrepreneur and the staff to buy back the equity. On the other hand, VCCs tend to demand that the SME sell out to a large competitor, or become a public company to enable the VCC to redeem its investment and take any profits. Companies such as Corporation Builders Pty Ltd and Enterprise Angels, provide a brokerage service to link SMEs with business angels. These brokers also tutor SMEs on the steps necessary to secure modest or larger injections of funding from the business angel and VC communities.

Financial institutions

In Australia, banks and other financial institutions tend to be unwilling to provide SMEs with funding, unless the SME owner can secure the funds with property. As most owners of SMEs have only sufficient personal property wealth to secure a few hundred thousand dollars in finance from these institutions, these institutions offer a limited source of investment funding.

Addressing the shortage of venture finance

As the above discussion suggests, a gap exists between the assistance measures Australian governments offer to small high technology companies and the requirements of these companies to successfully commercialise innovation. This gap is in the later stages of the process of commercialising innovation, namely from production unit development to initial production runs. To address this gap and improve the outcomes from innovation and investment, the following proposals are made:

- There is a need to review the VC industry.
- Revise the PDF program to ensure that a broader range of SMEs can access these funds. An SME could apply for investment capital in proportion to the commercial potential of their product or technology. The equity offset should be set to a maximum of 20 percent and there should be predetermined exit strategies.
- Encourage SMEs to collaborate with established multinational company supply chains in exporting projects (a global supply chain partnership program). The science industry has many multinational companies (MNCs) that have import/distribution outlets in Australia. 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. There is a role for government to encourage this type of 'reverse distribution' activity.

- Establish a national register of business angels. This could be developed by the relevant industry associations using any existing business angels listings that they may have. Government could also provide some assistance through its existing programs.

Support for larger enterprises – the views of a large manufacturer of scientific instruments

Introduction

In a global industry that is dominated by US companies, the Australian scientific instrument industry is performing well. The US industry not only has the largest market share in the production of scientific instruments, but its companies also dwarf those of other countries.

To improve Australia's current situation, the two most significant issues that will ensure that Australia's scientific instrument industry remains vibrant and highly competitive in global markets are:

- Government support for innovation; and
- Effective linkages between industry and publicly-funded research organisations.

Support for innovation

With the strong AU$ effectively weakening the export competitiveness of Australia's science companies, these companies will need to have a stronger focus on marketing their products. This is particularly the case for the larger science companies that export up to around 90 percent of their production. An integral part of to the SIAA is the continued support from Government for innovation, and this action agenda will assist companies in this regard.

The science industry is a knowledge intensive industry that relies on a continuing supply of innovative, globally competitive products, processes and services to fuel its growth. A shortage of investment to fund innovation is an impediment to sustaining the high levels of growth that companies require to compete effectively in global markets.

Central to designing measures to assist Australia's scientific instrument industry segment is a sound understanding of the mechanisms of innovation that lead to industry growth. Here, the support mechanisms that have led to the success of the dominant US companies in the science industry provide a role model for Australian policy makers.

The Australian science industry stands out as one of the large spenders on R&D and is heavily committed to innovation, as shown by a survey of the industry in 2004. It is also important to raise the level of entrepreneurial acumen in the industry.

The Australian scientific instrument industry segment recognises that the national governments of its competitors in the US, Japan and Canada support their companies to a far greater extent than Australian governments support their companies. For example, SGE derives greater benefits from US and Japanese government expenditure on R&D than it does from the Australian government. SGE is able to obtain such benefits when the US government provides financial assistance to US companies with which SGE or publicly-funded research organisations are collaborating. Contract research in the US which SGE has particular interests are in genomics, proteomics, environmental water monitoring and homeland security. Strategies such as these enable foreign governments to achieve their targeted technical objectives for research. Therefore, when companies are able to obtain greater assistance in the governments of other countries compared to Australia, it leads to an unequal playing field for Australia based companies that compete in the global market.

The Federal Government's "Backing Australia's Abilities" initiative has made a substantial commitment to R&D in Australia. However, any comparative analysis of international data in relation to R&D has proven to be extremely difficult. Data in publications from DEST are very useful, but it appears that for every conclusion that could be drawn from the data, it was also possible to find contradictory data from which an opposite view could be expressed. This is particularly the case with respect to the level and mechanisms of public support for business expenditure on R&D (BERD). Hence, while there is debate about the real level of government support for BERD in Australia, the observation of the scientific instrument industry is that expenditure is heavily skewed towards government institutions rather than towards industry.

It is interesting to note that there appears to be a misunderstanding of the real mechanism and value of the R&D Tax Concession. While all companies in this industry would be eligible to claim the concession, the foreign companies conducting research in Australia see no benefits deriving from it. Even for Australian companies claiming the concession, at best regard it as a relatively small cash flow issue which delays the payment of tax. Eventually the tax will have to be fully paid by the shareholder. Although the Government may see this as a relatively good incentive to encourage a greater commitment to R&D, in practice, the industry sees it as a relatively weak incentive.

It is also possibly erroneous to fully count it as a government contribution to business R&D. In addition, since the R&D Tax Concession was reduced from 150 percent to 125 percent, the incentive to invest in R&D has declined from 15 cents in the dollar to seven and one-half cents in the dollar. The industry notes that part of incentive has been eroded by the lowering of company tax rates.

The industry also considers that the management criterion of the R&D Tax Concession that must be satisfied by applicants is also quite onerous.

During the development of the SIAA it became clear that companies in the industry were lacking in a thorough familiarity with the assistance programs available from government. Where companies in the industry were familiar with innovation support measures, they considered that, in some cases, the administrative burden of programs outweighed the potential benefit that they could provide. The industry was pleased that the Government introduced the new Commercial Ready Program in 2004 to replace the former R&D START Grants Program.

The SIAA provided input to the development of the guidelines for Commercial Ready in 2004. Whilst a number of its suggestions were implemented in the guidelines, the industry remains concerned about two issues. Firstly, the science industry's larger companies are excluded from Commercial Ready because of the eligibility criterion that requires a company or company group to have an annual turnover of no more than $50 million. Secondly, the potential benefits that science companies derive from the R&D Tax Concession Program are outweighed by the compliance costs. Furthermore, as most companies require funding at the beginning of a project, the time at which funding is provided to a company during the development of a new innovation is inappropriate for the cash flow needs of the company.

The science industry is concerned that the capped $50 million turnover eligibility criterion placed on companies applying for innovation support programs such as Commercial Ready, is unrealistic and it acts as an impediment to further investment in R&D.

The science industry is a global industry, where the size of many company groups is likely to be in excess of $500 million. Australia's science companies are small in global terms, the largest possibly having an annual turnover of only around $200 million. However, the needs of Australia's larger science companies do not differ greatly from those of the smaller ones. The effect of the $50 million limit is that the Australian subsidiaries of multinational companies are denied access to many Government R&D support measures. The industry considers that a limit of $200 million would be more realistic.

While many science industry companies belong to a larger group, the head office of the group does not necessarily provide its subsidiaries with access to funds they need for investment in R&D. In cases where the foreign parent company supports the R&D investments of their Australian subsidiaries, they also place limits on their overall global R&D investments. This leads to the Australian subsidiaries having to compete with the other subsidiaries for the investment funds of the group. Also, the foreign parent may also impose a limit on the R&D investment of its subsidiaries.

Commercialisation of public sector research

There is a consensus in the Australian science industry and government that much of the scientific instrument industry in Australia developed from linkages with CSIRO during the 1960s. While the developments in scientific instruments were by-products of other CSIRO projects, the various commercialisation mechanisms that enabled the birth and development of the industry at that time were quite effective.

Unfortunately, these mechanisms have been allowed to deteriorate over the past 15 or so years. It is only now that there seems to be a willingness by government to re-establish the linkages and mechanisms that will sustain an even more vibrant scientific instrument industry.

Complementing this development is the SIAA whose highest priority is to commercialise a significantly greater proportion of intellectual property from Australia's publicly-funded research. As part of its deliberations, the SIAA concluded that effective linkages between industry and publicly-funded research organisations are the most powerful mechanism for generating new industries and significant wealth for Australia. At a minimum, these linkages can take the form of relatively simple interactions between industry and CSIRO.

A very large proportion of companies in the Australian scientific equipment segment of the science industry owe their existence, or at least a substantial part of their success, to developments provided directly by publicly-funded R&D organisations such as CSIRO. These interactions have been at many different levels from commercialising new technologies developed within public funded R&D organisations through to informal advice from the intellectual capital that exists within the organisations. All have been extremely valuable and have played major parts in developing the industry.

Up until the 1980s, the linkages between CSIRO and industry were highly effective and led to the development of a number of businesses that have grown to be the largest in Australia and highly successful in the global market. This submission provides a number of case study examples of these successful interactions. However, since the 1980s it appears that the commercial outcomes of these linkages have not been fully appreciated or valued outside the industry. It is only recently that Government has renewed its interest achieving greater commercial outcomes, and it is striving to improve its understanding of the mechanisms that will be most effective.

As part of the current exercise to derive better outcomes from publicly-funded research there is a push for government research institutions to obtain a greater proportion of R&D expenditure from industry. This has led to the performance of these research institutions being measured against this parameter.

The key performance indicators (KPIs) used in the National Survey of Commercialisation, particularly the financial indicators are not credible measures. There is no justification for setting a revenue target of 2.5 percent of expenditure to be derived from contract R&D or the sale of intellectual property from research. Nor is it justified to state that this revenue target is the indicated average in Australia. Whether the result is 2.5 percent or 10 percent, it is an irrelevant measure of performance. To measure the success of publicly-funded organisations by the proportion of their income derived from external sources is not only inappropriate, but it often drives counterproductive behaviour in the relationship between research organisations and the external sources such as industry.

What is even more disturbing is that when these KPIs are applied to organisations such as Stanford University, Penn State and MIT in the US, would lead to them being classified as 'underperformers'. These organisations have created whole economic zones by virtue of being a centre of expertise for new technologies, and are clearly not underperforming by any measure. As such, these organisations tend to be nucleation sites for companies in the same way that CSIRO was in Melbourne during the 60s, 70s and early 80s for the scientific instrument industry. In the US, each new wave of US companies in the scientific instrument area tends to originate from publicly-funded R&D.

Consequently, any measure of the effectiveness of publicly funded research organisations should be linked to the socio-economic outcomes arising from the research in the community from which the funding is sourced.

Finding appropriate KPIs for publicly funded R&D is a significant issue and one with which other countries have wrestled. The current debate on this issue in the US challenges the use of 'number of patents' as a KPI, and alternative KPIs are being sought. KPIs that have been suggested as more relevant measures (provided relevant data can be collected) are, for example, 'number of new products taken to market' and 'income from new products'.

Networks for innovation organisations

Industry experience clearly demonstrates that formal and informal networks are a very powerful method for sharing the industry's collective learning, current market intelligence and information, and potentially useful developments from research. The Australian Scientific Industry Association (ASIA) of the 1980s is an excellent example of where such networks existed. The successor industry organisation, Science Industry Australia Incorporated, led the development of the Science Industry Action Agenda in collaboration with Government. The Action Agenda has as one of its action priorities, the fostering of such networks complemented by mentoring from the science industry's wealth of explicit and tacit knowledge.

Conclusion

Government has many excellent assistance measures available to SMEs for research and development. However, Government should add to this range by enabling SMEs to gain easier access to funding to support the later stages of product commercialisation. This would enable high technology SMEs to grow their businesses faster and to become $50 million to $100 million companies that can compete more sustainably in international markets. In so doing, they will grow Australia's national wealth.

Government could improve its assistance to larger scientific instrument companies by making its support measures for innovation more world competitive. The industry is pleased that the Government is currently focusing its attention on improving the commercialisation outcomes from its investment in innovation support measures.

Case studies on successful innovation

Case study – NIR Technology Australia

NIR Technology Australia (NIRTech) is a wholly Australian owned company that specialises in the design and manufacture of near infrared (NIR) spectrophotometers and spectroanalysers used to measure certain properties of agricultural products, foods, drinks and medicines. The instruments do this by analysing the NIR light reflected from the specimen to determine its characteristics.

In the late 1980s, the Australian Wheat Board (AWB) identified a need for a better way to determine the protein and moisture content of the wheat it was buying from growers around Australia. AWB needed this information to determine the price that it offered growers and the storage requirements for the grain. It was proposed by AWB that it make an initial purchase of 400 such spectro-analysers.

At the time, Phillip Clancy had just returned from four years experience working with the US company Pacific Scientific, and was well placed to develop an analyser in Australia to meet AWB's requirements.

In 1996 Phillip partnered with Cooperative Bulk Handling (CBH) in Western Australia to develop the analyser. The Australian Government's Industrial Research and Development Board assisted the project with a grant.

A prototype instrument, the Ceres 2000G, was trialled in 1998 and sales commenced in 1999. The Ceres 2000G brought new innovations to existing instruments available from other manufacturers. The prototype had virtually no moving parts. It was light weight, portable, and simple to manufacture at a much lower cost.

In 2000, NIRTech was formed to continue the development of the technology. Later that year the Cropscan 2000G analyser was launched. Like the Ceres 2000G, the Cropscan 2000G was designed for Australian conditions. NIRTech has continued to develop, manufacture and market NIR analysers. It now has seven models designed for use in the field; on the laboratory bench; in bulk handling equipment used to move grain such as pipes, augers and conveyors; and on harvestors. The instrument can be coupled with a GPS system to produce yield maps of paddocks.

The Cropscan 2000G is now NIRTech's principle revenue earner. NIRTech sells its instruments directly to users in Australia and through distributors in North America, Italy, France, UK, Eastern Europe, Asia and India. The company has sold over 380 instruments, half of which Australian farmers have purchased, and the remainder have been exported.

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.

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

Case study – Ai Scientific

Ai Scientific offers specialised laboratory automation products for sample preparation, delivery and sample tracking through the laboratory process. The company's international head office, design and manufacturing facility is located at Clontarf in Brisbane. Ai Scientific also has offices in Sydney, Melbourne, Auckland, Pittsburgh (USA) and distributors throughout North America, Europe and Asia. Since 1985, Ai Scientific has generated over $30 million in export sales and grown its revenues at a compound rate of 24 percent per annum on average.

Ai Scientific's international success is based on the following well-established business practices to secure and maintain strategic competitive advantage:

1. Customer focus. Ai Scientific's priority is to provide its customers with innovative, cost-effective solutions that improve laboratory efficiency in the processing of increasing numbers of samples. It complements this with complete and ongoing after-sales support.
2. Focus research and development efforts on niche markets. Ai Scientific is one of six global manufacturers of auto-samplers for inorganic analysis, and one of 14 companies that provide pathology sample management systems.
3. Mobilise the experience, skills and creativity of its staff. Ai Scientific uses multi-disciplinary workplace teams of staff from sales, and research and development to share ideas on how to improve product and service delivery.
4. Think globally and act locally. Ai Scientific's strong international market focus is built on accurate market intelligence and the identification of emerging trends. The company encourages its business unit managers to travel overseas six to eight times per year to attend international trade shows, develop relationships with European and USA companies, and to promote international market awareness of the Ai Scientific brand.
5. Dedication to reducing costs while continually improving product and service quality. Ai Scientific uses strategic purchasing policies and key supplier agreements to ensure the highest quality from its suppliers.

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.

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.

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.

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.

Case study – Thermo Electron Clinical Chemistry

Thermo Electron Clinical Chemistry (TECC), a Melbourne based producer of *in vitro* diagnostic reagents and media for cell and tissue culture, was born global as Trace Scientific Ltd. in 1985.

By the early 1990s was successfully supplying its core technology products to laboratories in North and South America, Europe and Asia. To support these markets, the company had established a distribution network that included a fully owned subsidiary in the USA and joint equity ventures in China and Eastern Europe.

In 1998 the company was purchased by Thermo Electron, one of the worlds leading scientific instrument companies. It is an integral part of the Clinical Diagnostic Division of Thermo Electron's Life and Laboratory Sciences sector.

In 2004 its turnover was over $30 million. TECC employs around 100 staff in Australia, USA and Europe, 60 percent of whom are tertiary qualified. It conducts R&D and supports a variety of external R&D projects with leading Australian universities and researchers which have a high success rate.

To sustain its well established reputation in the market, TECC's manufacturing operation meets the demanding quality standards of the US Food and Drug Administration and the EU *In vitro* Diagnostic directive.

TECC has positioned itself as a leading supplier of *Infinity*™ diagnostic reagents through the design and development of unique differentiated products that have a clear technology advantage over the competition. Its reagents are used for diverse applications such as the treatment of dipolar depression, the diagnosis of liver disease, and the identification of lymph node disease.

TECC designs, develops and manufactures a range of sterile media for use in cell and tissue culture that are used in the laboratory, or in the large scale production of proteins for use in the therapeutic, food or beverage industry. Because Australia is free of 'mad cow disease', TECC has developed a strong niche market for its Foetal Bovine Serum culture media.

On the back of its success in manufacturing diagnostic reagents, and the emerging trend for laboratories to demand 'ease of use products', TECC embarked on a strategic R&D program to develop and patent a state-of-the-art process for manufacturing liquid reagents that remain stable. The aim of the R&D program was to further develop TECC's sustainable competitive advantage and fuel its next growth phase.

TECC strengthened its market position in the burgeoning biotechnology industry by leveraging its market assets of a well developed distribution network, emerging licensing opportunities, collaborative relationships with public/private research institutes, experience in the increasingly complex regulatory environment and world-class reputation for quality products.

TECC's OEM customers include industry giants in the *in vitro* diagnostic market such as Bayer, Beckman Coulter, and Olympus.

Case study - A&D Mercury Pty Ltd

A&D Mercury Pty Ltd is a Japanese owned SME manufacturer of industrial weighing equipment established in 1946. The company has a production facility in Adelaide and is a dominant supplier to the Australian market, and it exports to Japan, US, South East Asia and Europe.

Prior to July 2003, A&D Mercury was unprofitable, struggling to satisfy the quality requirements of its parent company and was in danger of losing its manufacturing rights in Australia. To recover the situation, company management had to change its attitude to quality and how to achieve it its manufacture of scales and balances. Since implementing its quality improvement and management program none of its products have been rejected by customers.

A&D Mercury's quality improvement and management program has the following elements:

- Improved communication between the parent company, local management and employees. This includes having:
  - Clearly defined quality goals;
  - A company vision to aspire to; and
  - Improved use of information technology for communication with their parent company which uses digital image transmission of products, processes and teleconferencing.
- Quality training by the parent company to improve:
  - A&D Mercury's understanding of Japanese market requirements; and
  - A&D Mercury's understanding of head office's expectations.
- Stable employment to retain expertise and the quality culture developed in A&D Mercury.
- Implementation of the Japanese 5'S program to improve shopfloor layout, production line flow and maintain a clean and tidy production area.
- Semi-automated production line for testing and calibrating scales.
- ISO9001:2000 accreditation with regular audits by BVQI.

Case study - SGS Australia Holdings Pty Ltd

SGS Australia Holdings Pty Ltd is a significant player in the laboratory and technical services industry in Australia. It is a subsidiary of the Swiss-based SGS Group, founded in 1878. SGS Group provides independent inspection, verification, testing and certification services for international trade in agriculture, minerals, and petroleum and consumer products. SGS Australia's commitment in excellence in providing its services is backed by ISO 9002 quality certification.

The SGS Group operates around 1 000 laboratories with over 39 000 employees in over 140 countries in Africa/Middle East, America, Asia/Pacific and Europe. Its Australasian operations were established in 1950 and now have over 1 000 employees in 44 establishments in Australia, New Zealand, Papua New Guinea and Fiji. Lakefield Research Ltd, referred to in another case study, is also a member of the SGS Group. It is a CA$40 million per annum Canada-based company. Lakefield has facilities in Canada, Australia, South Africa, Brazil and Chile.

To build its brand, network and market presence, the SGS Group acquired the publicly-listed Scientific Services Ltd (SSL) in 2001. SSL's network of laboratories specialises in the testing of soil, mineral ores, water, agricultural commodities and food based products. SSL has become a major earner for SGS Australia with revenue of AU$58 million in the year ending December 2003.

Australian Government
Department of Industry, Tourism and Resources
Department of Education, Science and Training

Science Industry Australia

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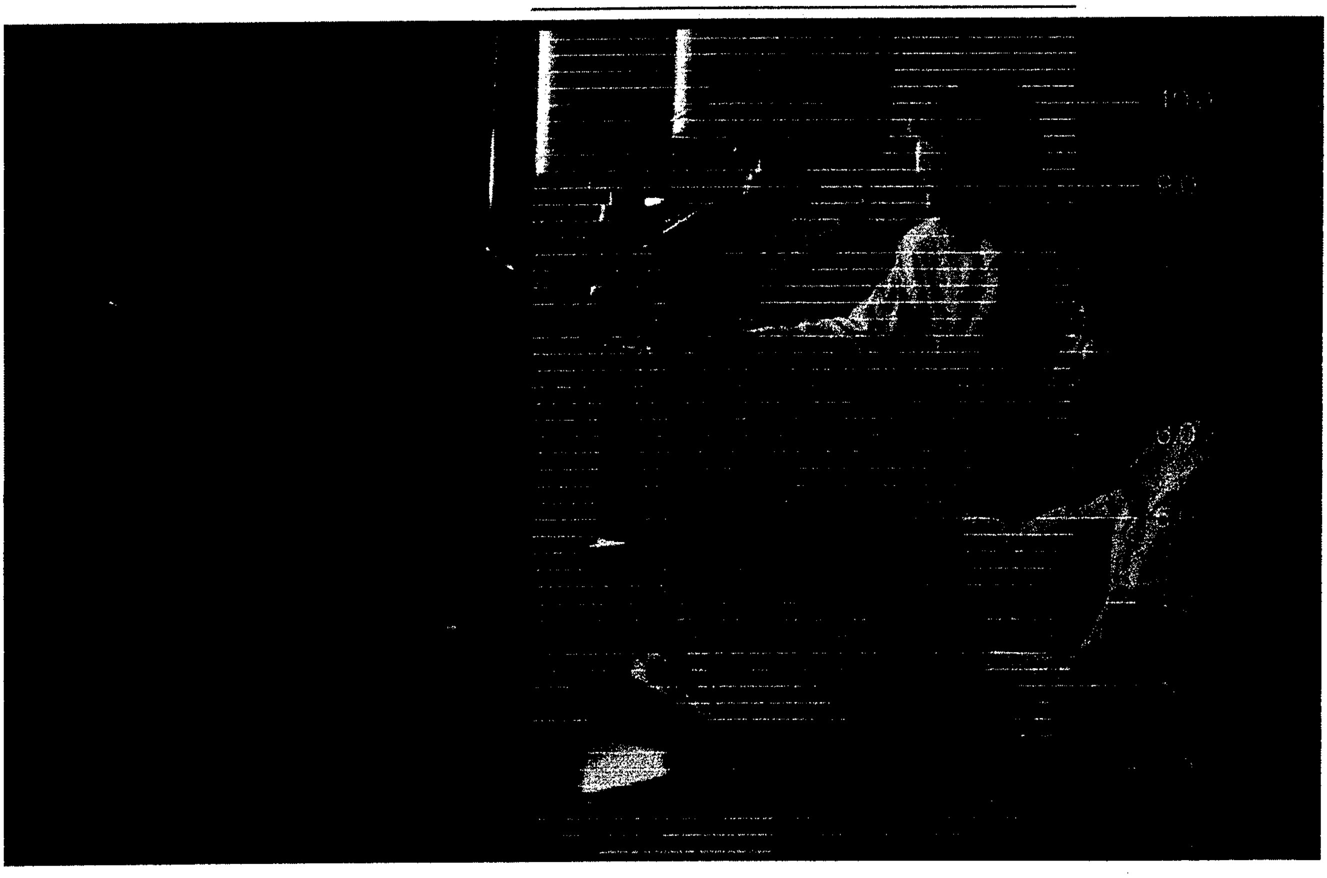

Cover Photo: QEMSCAN instrument, courtesy Intellection Pty Ltd.

ISBN 0 642 72414 8

ITR 2005/024

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