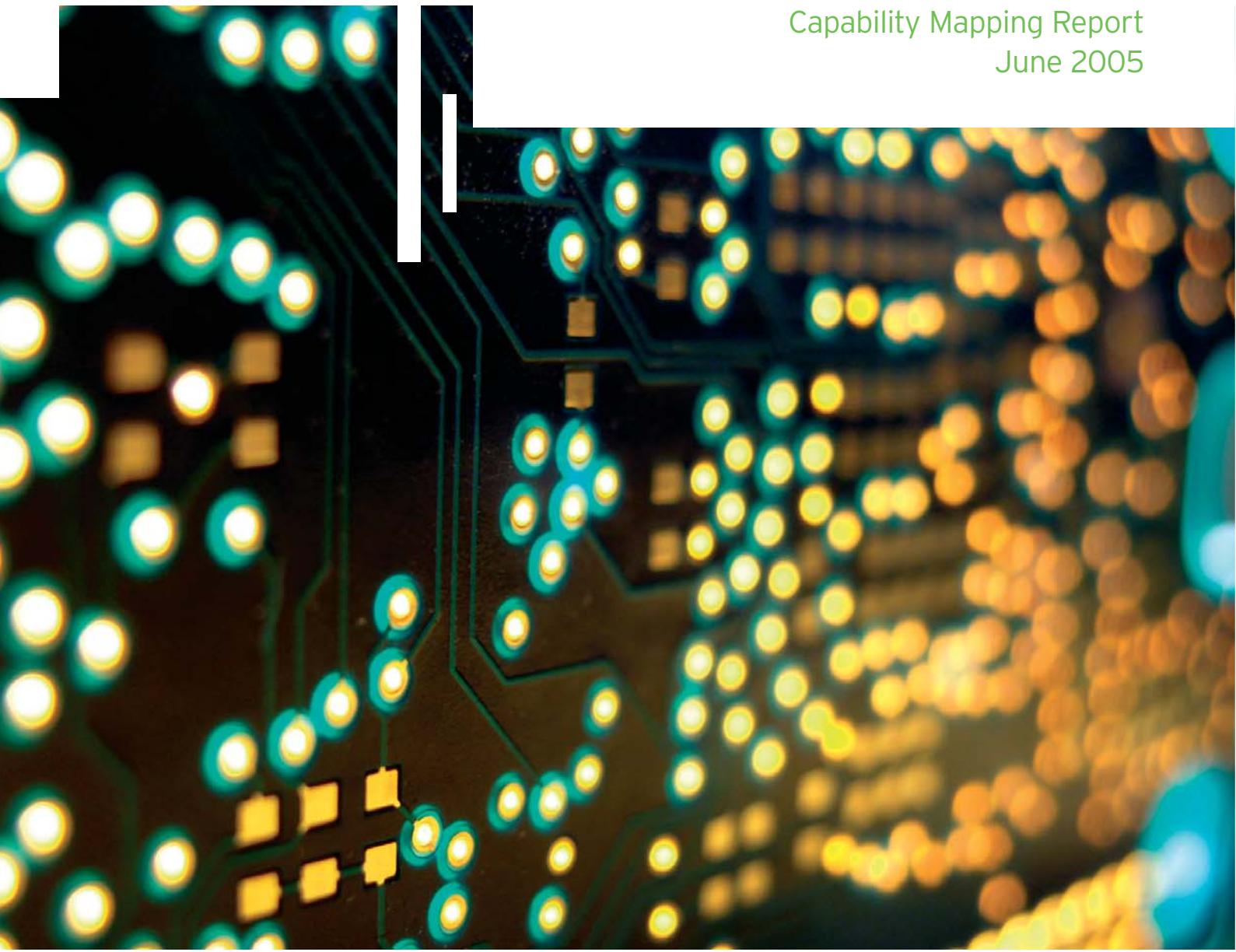


# Australian Electronics Industry

Capability Mapping Report  
June 2005



THE FUTURE IS | | here

Technology Australia



Australian Government  
Department of Industry,  
Tourism and Resources

Invest Australia



1. 2.

**John Houghton**  
(Centre for Strategic Economic Studies)

**Max Rose**  
(Chair, Electronics Industry Action Agenda Mapping Group)

**John Humphreys**  
(Global Innovation Centre)

**Peter Morris**  
(Telsesis Consulting and Research)

**Jennifer Liston**  
(Australian Electrical and Electronic Manufacturers' Association)

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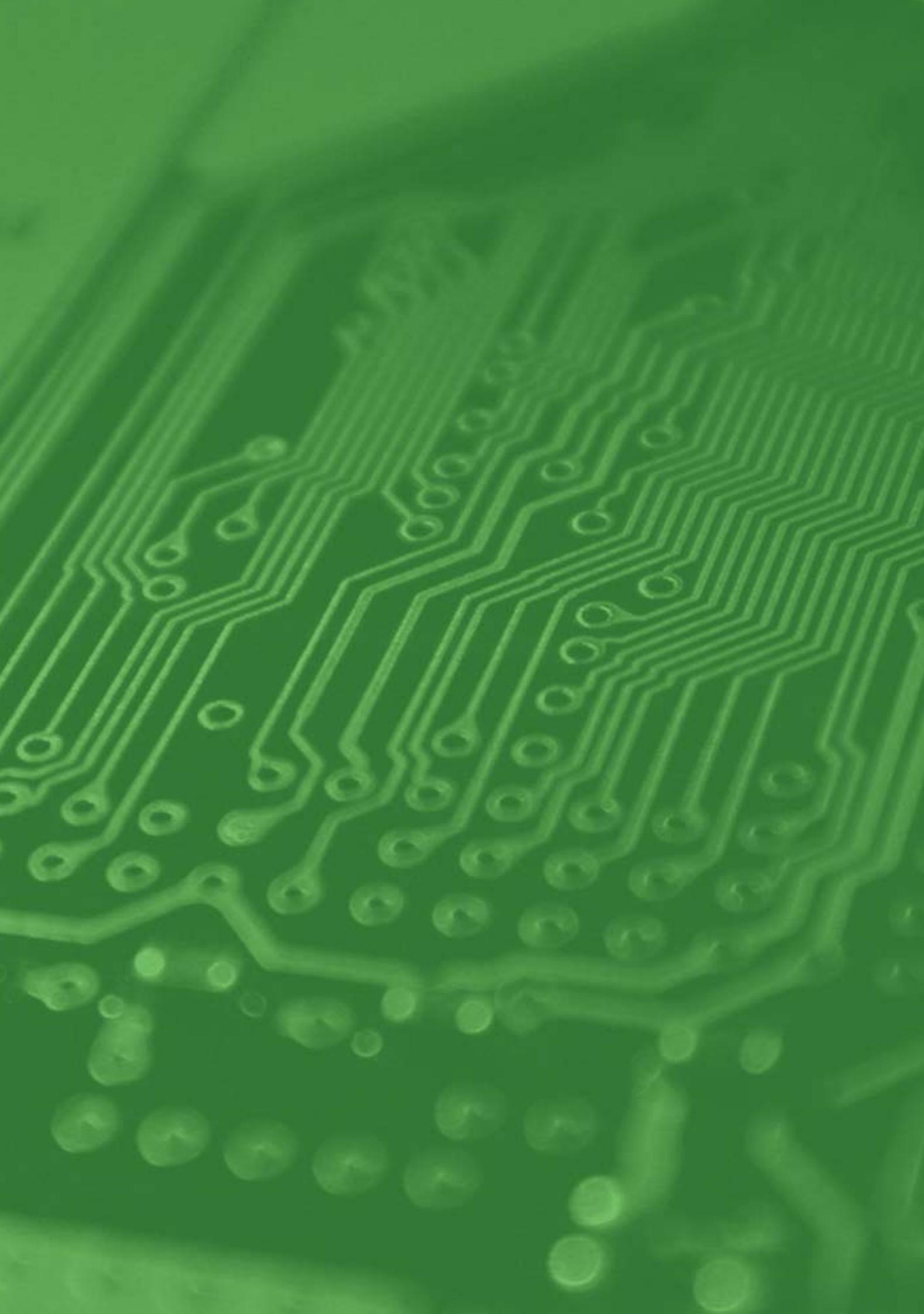
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#### Images

1. Copper bromide laser, designed and manufactured in South Australia by Norseld.
2. Gemplus Tag Australia is testing experimental semiconductor fabrication techniques to help produce state-of-the-art integrated circuits for a range of commercial applications.
4. (Inside Back Cover) Photo of e-waste Product Ecology Pty Ltd

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## FOREWORD

### MESSAGE FROM THE MINISTER

The electronics industry is a significant part of the Australian economy. As such, the Australian Government is continuing to work with the industry to implement the Electronics Industry Action Agenda (EIAA).

Among other key tasks, the Action Agenda committed industry, with the support of government, to undertake comprehensive cluster mapping to identify its existing capabilities and gaps in the innovation and supply chain.

This report identifies major electronics industry market verticals in Australia, including: defence and aerospace, automotive, communications and IT, scientific and medical instruments. A range of niche strengths relating to mining and agriculture, transport and marine, building and construction have also been identified.

In addition, this report identifies key electronics capabilities across Australia. The largest numbers of electronics firms are in Victoria and New South Wales; Queensland has strong capacity in some niche telephony and photonics products; South Australia in defence, home and automotive electronics; Western Australia in smart cards and a number of other niche products including those related to the resource industries; and the Australian Capital Territory has niches in photonics, defence and remote sensing.

It is envisaged that this report will be a working document and revised annually to remain current. With continued leadership and support from the industry, this report will provide a constructive way forward as well as providing a guide to investors on opportunities and capabilities available across Australia.

This has been a collaborative effort and I would like to thank the members of the Mapping and Value Chain Working Group, the Implementation Group of the EIAA, state and territory governments and AEEMA for their work in developing the report.



**The Hon Ian Macfarlane MP**

*Minister for Industry,  
Tourism and Resources*

## KEY POINTS

### Trends and challenges

#### **Australia's electronics industry faces a number of challenges.**

There is: fragmentation of the value chain, with standardisation and modularisation supporting increased outsourcing and specialisation; a need to develop new business models moving towards increasing knowledge intensity and flexibility; a need to make better use of internet-based technologies and e-business applications to support supply chain management and integration; greater recognition of environmental and regulatory demands for the removal of 'materials of concern' and increased whole-of-life 'product stewardship'; and the emergence and cross-fertilisation of new and converging technologies. As a result, emerging cluster strengths require hitherto disparate skills, and the future of regional clusters depends upon their combination and coordination, and the strength of industry commitment.

### Strengths and capabilities

#### **Australia's electronics industry is active, innovative and resourceful.**

While much activity is concentrated in New South Wales and Victoria, there are many innovative firms in other states. Queensland and South Australia are the base for leading activities in a number of vertical markets, while Western Australia and the Australian Capital Territory have electronics firms focused on local niches with significant export potential.

Major market verticals include: defence and aerospace, automotive, communications and IT, scientific and medical instruments. A range of niche strengths relating to mining and agriculture, transport and marine, and building and construction are also evident. Australia has strengths in photonics and opto-electronics, microelectronics, nanotechnology and micro-electro-mechanical systems (MEMS). Chip-on-board and chip-on-glass manufacture, laser welding, and flexible circuit board manufacture are less developed.

These underlying technologies translate into applications, with local capabilities including telematics, security, home automation and networking, e-tag, e-toll and e-ticketing in transport, robotics and automation, as well as power electronics and remote sensing.

Beyond these, the Australian industry exhibits a number of important competencies, including product and systems design, testing and certification, small-scale, customised contract manufacturing, and a unique capacity for a combination of process innovation and systems integration (i.e. problem-solving). With many smaller firms operating throughout Australia, there is also a high level of collaboration, with vigorous networks and clusters operating in most centres.

## Building for the future

**In many areas, demand in Australia does not support the level of capital expenditure, specialisation and scale required to thrive.**

With inevitable consolidation among the smaller players, continued support for collaboration is essential for the formation of deep networks, clusters and alliances. Electronics product development and design tools have become increasingly expensive, often beyond the reach of smaller firms. A number of initiatives seek to address the issue of shared infrastructure, but to remain competitive, enhanced attention to shared infrastructure will be required.

Australia has many electronics manufacturing strengths, but there is a need to build capacity in chip-on-board and chip-on-glass manufacture, laser welding, and flexible circuit board manufacture to upgrade to international manufacturing practices.

With a decline in the number of large clients, local opportunities to participate in the development of solutions in 'lead projects' are minimal. Therefore, it is essential to support more lead and demonstration projects, with a greater resource commitment and longer time horizons.

The further development of opportunity and solutions oriented clusters provides a way forward.

# ELECTRONICS IN AUSTRALIA

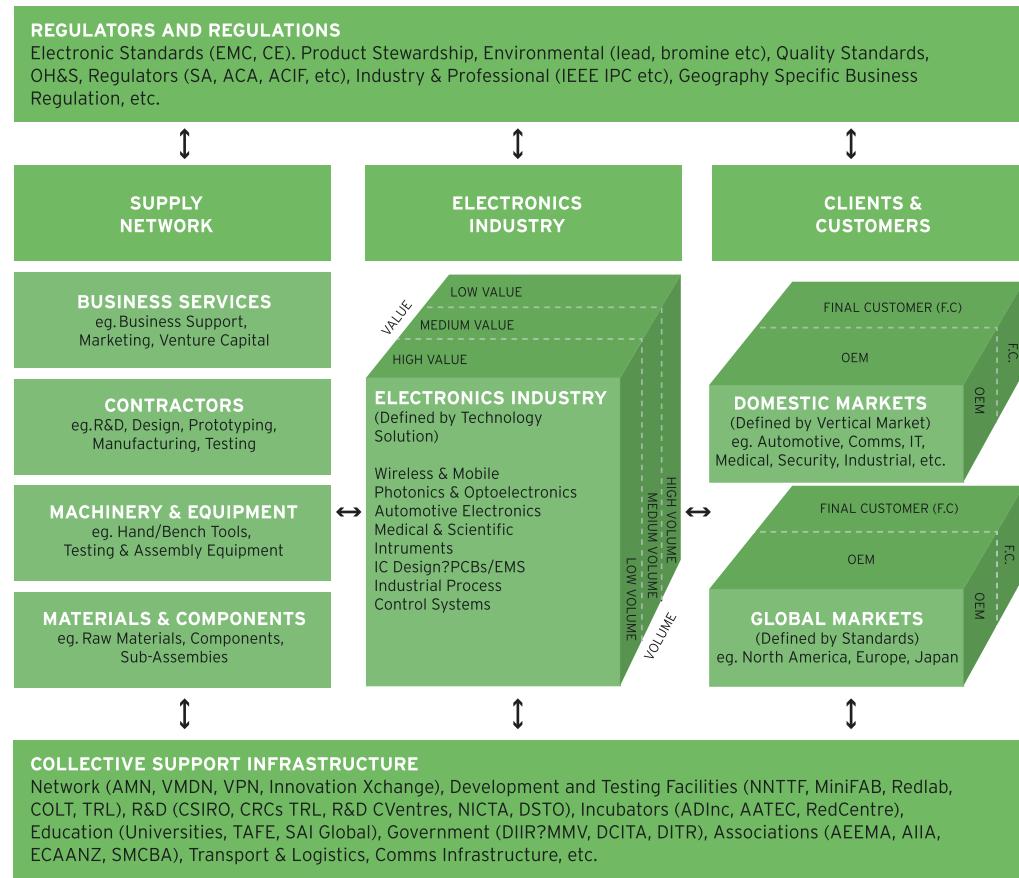
The electronics industry involves the entire value chain, from the design and manufacture of components and inputs to electronics manufacturing, through manufacturing and assembly, wholesale, retail, installation, maintenance and repair of electrical and electronic equipment. No developed economy or sophisticated industry can operate in the 21st century without access to a range of electronic products and services and to workers with electronics related skills<sup>1</sup>.

In recognition of the importance of electronics to the Australian economy, the Commonwealth Government joined with industry to launch the Electronics Industry Action Agenda. This report presents a brief synthesis of findings from the national capability mapping exercise undertaken as a part of the Electronics Industry Action Agenda's implementation.

## Capability mapping

A product system approach was taken to mapping the electronics industry capabilities<sup>2</sup>. Electronics firms (defined by technologies, solutions and/or vertical markets) were placed at the centre, their supply network to the left and clients, customers and markets to the right (Figure 1). These are supported by a collective infrastructure and operate within an overarching regulatory framework.

**FIGURE 1** THE VICTORIAN ELECTRONICS INDUSTRY

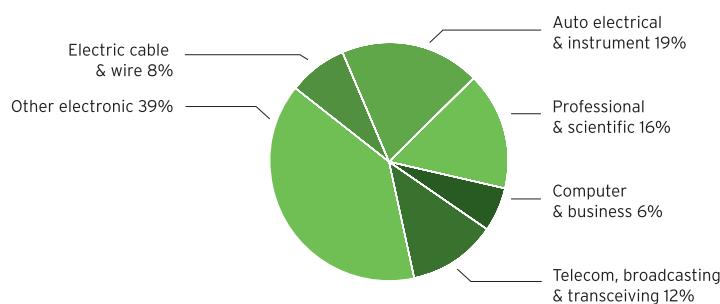


## Electronics industry activities

In 2002-03, the electronics manufacturing industry employed 31,556 people in Australia, realised turnover of \$8.6 billion and more than \$2.2 billion in gross product. Domestic demand for electronics manufactures in Australia amounted to \$24 billion in 2002-03, with imports accounting for \$19 billion of that total. Industry turnover amounted to \$8.7 billion, and almost \$3.7 billion worth of electronics equipment was exported.

Reflecting to extent of non-specialist production and contract manufacturing, 'electronic equipment manufacturing not elsewhere classified' accounted for around 39 per cent of total employment – employing 12,000 people. Automotive electrical and instrument manufacturing employed 6,050 (19 per cent), professional and scientific equipment manufacturing 5,160 (16 per cent), telecommunications, broadcasting and transceiving equipment manufacturing 3,734 (12 per cent), electric cable and wire manufacturing 2,632 (8 per cent) and computer and business equipment manufacturing 1,989 (6 per cent). (Figure 2).

**FIGURE 2**  
EMPLOYMENT IN ELECTRONICS MANUFACTURING IN AUSTRALIA, 2002-03 (PER CENT SHARE)



Source: IBIS, CSES Analysis.

Australia accounts for around 0.3 per cent of worldwide electronics production, with somewhat higher shares of telecommunication and radiocommunication, and control and instrument production. These higher shares suggest local strengths in control and instrumentation equipment and communications equipment. Conversely, Australia's production of electronic components is lower than its overall average.

# TRENDS AND ISSUES IN ELECTRONICS

**The electronics industry is being shaped by many forces<sup>3</sup>. These include:**

- Market trends and growth, with a return to growth in information and communication technologies (ICTs) and renewed growth in automotive and consumer electronics;
- The fragmentation of the value chain, with standardisation and modularisation supporting increased outsourcing and specialisation along the value chain;
- The need to rapidly develop new business models to support increased firm and regional specialisation;
- The drive to make better use of internet-based technologies and e-business applications to support supply chain management and integration;
- Environmental and regulatory demands for the removal of 'materials of concern' and increased whole-of-life 'product stewardship'; and
- The emergence and cross-fertilisation of new, converging technologies (e.g. microelectronics, photonics and nanotechnology).

## Market trends

Following the severe downturn of 2000–01, the worldwide electronics market now appears to be returning to annual growth rates of 5 per cent to 7 per cent. This is slower than the historical long-term trend, due to a combination of persistently slow market and production growth in developed countries. However, there is strong growth in developing countries, particularly China<sup>4</sup>. Major world market growth areas include:

- *Automotive electronics*—with demands for increased comfort, enhanced features, engine efficiency and safety increasing the electronics content of vehicles;
- *Consumer electronics*—with the replacement of cathode ray tube displays by flat screens and new consumer products, such as DVD-writers, digital set-top boxes and TVs, home cinema, digital cameras and game consoles revitalising the sector; and
- *Power electronics*—with increasing demands for security and uninterruptability of supply, mobility and the emergence of an ever wider range of mobile devices, and the development of electric and hybrid vehicles<sup>5</sup>.

## Structural change

Electronics industry sub-sectors vary in structure and dynamics. Whereas original equipment manufacturers (OEMs) can be vertically integrated, keeping large parts of the production and value creation process in-house, much of the electronics industry is now characterised by a high degree of specialisation along the value chain, with standardisation and the modular nature of electronic products supporting high levels of specialisation and outsourcing<sup>6</sup>. Increasingly, this fragmentation of the value chain is global, with the formation of specialised production clusters participating in global production systems.

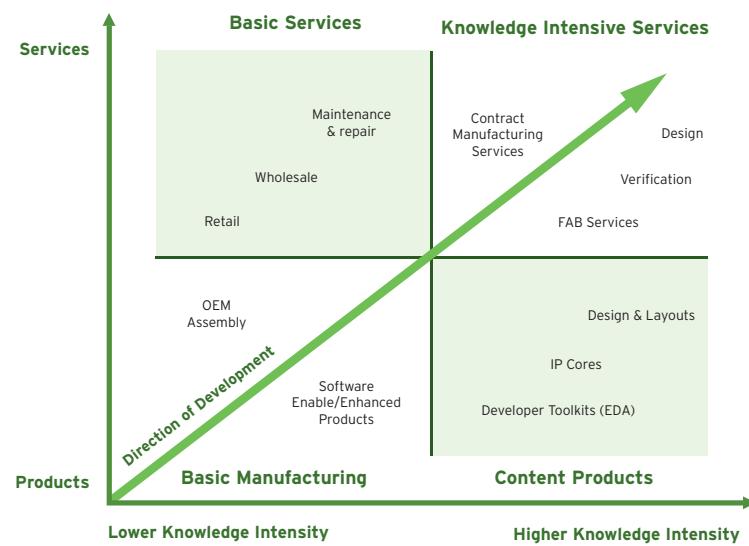
At the same time there are cross-cutting trends, with labour-intensive, volume manufacturing shifting to contract equipment manufacturers in Asia, while Western Europe and the United States retain the high-end, knowledge intensive stages of the value chain, such as research and product development<sup>7</sup>. Nevertheless, high unit volume products evolve quickly from small scale manufacturing near design centres of gravity, to large scale manufacturing near market centres of gravity, and finally to large scale manufacturing near low cost labour centres of gravity<sup>8</sup>.

Unable to compete with some developing locations on labour costs, and remote from major markets, Australia's electronics industry seeks to maintain a position as a design and development 'centre of gravity' and focus on areas that are lower volume by developing effective linkages between global markets and emergent high-value services (e.g. design and verification), IP-based products (e.g. IP cores, designs and layouts) and lower volume products (e.g. scientific and medical equipment, instrumentation and industrial process control) (Figure 3).

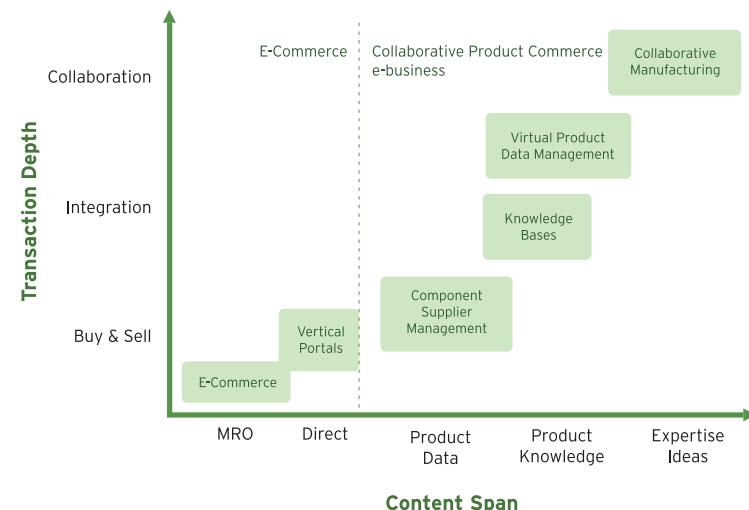
### Managing the supply chain

This rapid evolution of industry structures, value chain fragmentation, the emergence of new business models, and increasing firm and regional specialisation are making supply chain management increasingly important. As well as offering the potential to increase productivity, the use of internet-based technologies and e-business techniques support outsourced operations that require loosely coupled business processes spanning multiple companies<sup>9</sup>. The ability of Australian electronics firms to operate effectively and efficiently within global and highly automated supply chains, moving towards collaborative design and manufacturing, is a key determinant of their ability to access world markets (Figure 4).

**FIGURE 3** DIMENSIONS OF SPECIALISATION AND DEVELOPMENT IN ELECTRONICS



**FIGURE 4** COLLABORATIVE PRODUCT COMMERCE



## Environmental and regulatory concerns

To meet regional environmental requirements, electronics manufacturers must remove 'materials of concern'. There is increasing pressure to ensure product recyclability and even conduct recycling, and an increasing focus on lowering energy use—both in manufacturing and in product operation. There is also greater focus on 'product stewardship', with the electronics industry facing product end-of-life or producer responsibility legislation in some markets<sup>10</sup>.

For example, the European Union has introduced Restrictions on Hazardous Substances (RoHS) in electrical and electronic equipment, which restricts the use of lead, mercury, cadmium, hexavalent chromium and brominated flame retardants (polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)). These substances are effectively banned from products sold in Europe from 1 July 2006.

In addition, the European Union Waste Electrical and Electronic Equipment (WEEE) Directive establishes extended producer responsibility legislation, and states that producers will be responsible for taking back and recycling electrical and electronic equipment<sup>11</sup>.

Such demands raise two issues. First, how to manufacture in such a way as to comply and manufacture products that comply from a technological point of view. Second, how to establish and operate the systems to enable, support and manage conformance. Environmental legislation in various product segments requires the electronics industry to share detailed material content data on their products and components and to establish systems for product stewardship. The adoption and use of sophisticated e-business applications and supply chain information systems will play a crucial role.

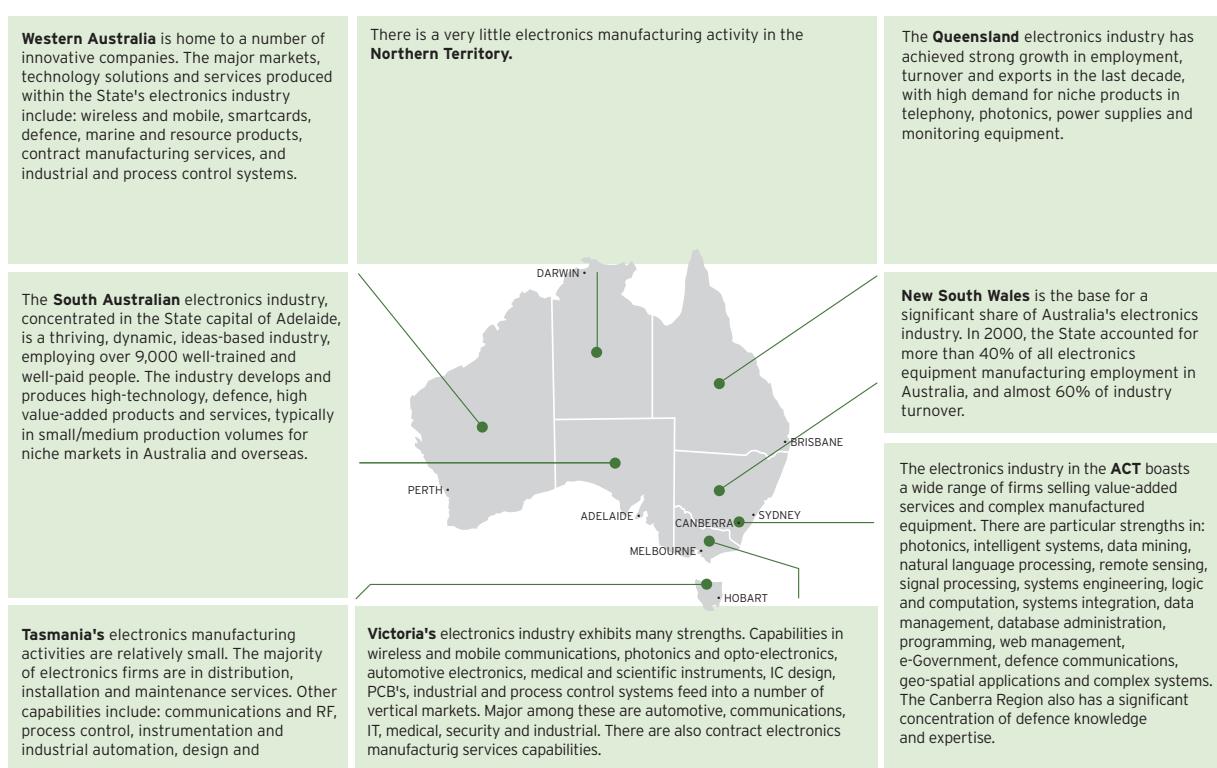
## Electronics futures and convergence

It has been widely noted by futurists that many of the more important technology trends of recent years have points of intersection. Indeed, convergence has been seen as a 'mega-trend', with cross-fertilisation of technology trends driving each other further and faster. Crucially, electronics is a vital enabler and key participant in many of these converging trends. It is, for example, becoming increasingly difficult to separate microelectronics, photonics and nanotechnology. As a result, emerging local industry and cluster strengths require hitherto disparate skills, and the future of regional clusters depends upon their combination and coordination.

# CAPABILITIES

Australia's electronics industry is active, innovative and resourceful. While much activity is concentrated in the larger states (New South Wales and Victoria) and within their major cities (Sydney and Melbourne), there are many innovative firms in other states and centres. Queensland and South Australia are the base for leading activities in a number of vertical markets, while Western Australia and the Australian Capital Territory have electronics firms focused on local niches with significant export potential. One characteristic of firms in the smaller states is that those that are exporters have a very strong export focus.

**FIGURE 5**  
AUSTRALIA'S ELECTRONICS INDUSTRY



Expenditure patterns reflect state strengths, with Victoria and New South Wales each accounting for 35 per cent to 40 per cent of core ICT equipment and instrumentation expenditure, but Victoria accounting for 60 per cent of all R&D expenditure in related transport and machinery equipment fields. As a result, Victoria accounted for some 50 per cent of all electronics and related R&D expenditure (Figure 6).

Electronics manufacturing industry employment stood at around 33,300 in 2000. New South Wales and Victoria accounted for 44 per cent and 36 per cent, respectively. South Australia, Queensland and Western Australia also boasted significant electronics manufacturing employment. New South Wales, Victoria and South Australia all had a higher share of electronics manufacturing in total manufacturing jobs than was the case nationwide. Electronics engineers, professionals and trades people are employed across a wide range of industries.

In 2002, there were almost 103,000 people with electronics skills employed in Australia, of which 39 per cent were in New South Wales, 23 per cent in Victoria, 16 per cent in Queensland, 10 per cent in Western Australia and 7 per cent in South Australia (Figure 7).

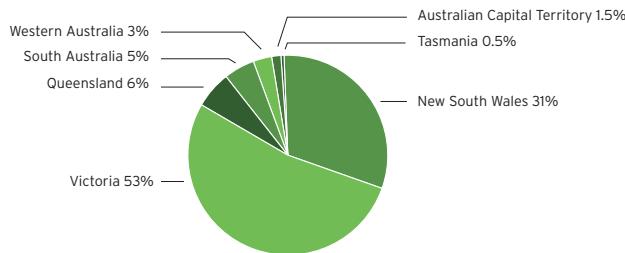
Specific electronics industry capabilities relate to major vertical markets served, key applications, technologies and the skills and competencies to be found in Australia. These include:

- Vertical market supply capabilities focusing on automotive electronics, communications, defence and aerospace, scientific instruments and medical devices, mining and agriculture, sensing and environmental monitoring, transport and marine;
- Applications capabilities relating to telematics, security, home automation and networking, e-tag, e-toll and e-ticketing in transport and logistics, robotics and automation, power electronics and remote sensing; and

- Fundamental technologies that are the bedrock of electronics, including photonics and opto-electronics, microelectronics, nanotechnology and micro-electro-mechanical systems (MEMS), chip-on-board and chip-on-glass manufacture, laser welding, and flexible circuit board manufacture.

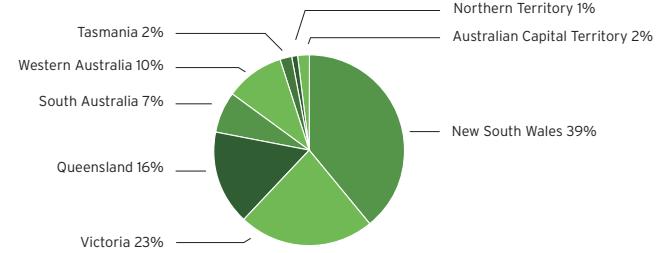
In addition to these, the Australian electronics industry exhibits a number of important capabilities. These include product and systems design, rapid proto-typing, testing and certification, small-scale contract manufacturing and a unique capability for a combination of process innovation and systems integration (i.e. problem-solving). With many smaller firms operating throughout the value chain, there is also a high level of collaborative competence.

**FIGURE 6**  
ELECTRONICS AND RELATED R&D EXPENDITURES BY STATE, 2000–01



Source: ABS unpublished data. CSES Analysis.

**FIGURE 7**  
EMPLOYMENT IN ELECTRONICS RELATED OCCUPATIONS, 2002



Source: ABS (2003) *Australian Now: Australian Labour Market Statistics, 2003*, Cat No 6105.0, Canberra. CSES Analysis.

## MARKET VERTICALS

The Australian electronics industry supplies a wide range of innovative products to its customers. Major market verticals served include: defence and aerospace, automotive, communications and IT, scientific and medical instruments. A range of niche strengths relating to mining and agriculture, transport and marine, building and construction are also evident.

### Automotive

The automotive industry is one of Australia's key manufacturing sectors and is now competing successfully in global markets. There is a strong inter-dependence between the car makers and their suppliers, and strong linkages with the rest of the economy. The four motor vehicle producers operating in Australia are based in Victoria and South Australia. Their production is supported by a supply chain with the capacity to design and manufacture the full range of parts and components. Australia has sophisticated production capacity in areas such as engines, panels, braking and clutch systems, suspension systems, exhausts, transmissions and rear axles, air conditioning, occupant safety, vehicle instrumentation and electronics, lighting and mirrors, and wheels and tyres. There are over 200 automobile component firms, around 500 small firms providing tooling to vehicle and component producers, and a number of other firms that provide specialist automobile services<sup>13</sup>.

The automotive industry is increasingly looking to electronics to differentiate new products, and the embedded electronics content of vehicles is rising rapidly. Australian motor vehicle and parts manufacturing revenue was \$24 billion in 2002-03,

with automotive electrical and instrument manufacturing accounting for \$1.4 billion and component manufacturing a further \$5.7 billion. Automotive electrical and instrument manufacturing sales have grown rapidly, from \$900 million in 1995-96.

**Victoria** is the centre of Australia's automotive industry, with key assemblers, component manufacturers, design houses, toolmakers and other automotive businesses providing 57 per cent of Australia's automotive production, 62 per cent of all engine and components exports, 70 per cent of automotive research and development, and 57 per cent of national component production. Ford, Toyota and General Motors Holden all have a large presence in Victoria, along with over 100 Australian, European, Japanese and American component manufacturers, which collectively account for \$5.1 billion in annual component production<sup>14</sup>. Victoria's automotive electronics suppliers include: Robert Bosch, Siemens VDO, Australian Arrow, Denso International/Australian Automotive Air, Air International, AME Systems, Flexdrive Cables (mechanical and electronic instrumentation), PBR (Brakes), Hella Australia, Sumitomo (Connectors and Drives), and many others.

- *Robert Bosch* employs almost 2,000 people and generates annual sales of around \$850 million, of which some \$520 million is from own manufactured equipment and \$365 is from exports. Around 75 per cent of sales are original equipment to the automotive industry. Robert Bosch invested \$30 million in a wafer manufacturing facility in Melbourne.
- *Australian Arrow*, a subsidiary of the Yazaki Corporation, is the largest supplier of wire harnesses to the Australian automotive industry. Australian Arrow manufactures a range of remote entry, engine control, embedded security and telemetry systems for leading car makers.
- *Australian Automotive Air* employs around 450 people in the manufacture of automotive air-conditioning and radiator components and, more recently, instrument clusters. There are a further 100 or more employees at the Denso Corporate Office in Melbourne.
- *AES (Automotive Electronic Specialists)* designs and manufactures the Execulog and Fleetcom brands of on-board-computers for the transport industries. These on-board computer systems are installed into the driver's cabin to monitor important vehicle and driver parameters.
- *Siemens VDO* is a supplier of instrument clusters to some of the world's leading car makers.

- *AME Systems* manufactures wiring harness and signal distribution systems for automotive and other transport applications. Employing around 230 people, AME specialises in low to medium volume manufacture of electrical harness to the OEM market.

Production, employment and sales data all suggest considerable strength in automotive electronics in Victoria. Forecast world growth data suggest that it is an area of considerable potential, as the electronics content of vehicles increases and new areas of opportunity emerge—such as tracking, navigation, telemetry and the introduction of electric and hybrid vehicles. The recent establishment by Toyota of an R&D centre focusing on electric vehicles provides opportunities and impetus in this area. There are also rapidly developing opportunities in Intelligent Transport Systems.

The automotive industry is also the largest single manufacturing industry in **South Australia**, with more than 13,000 people directly employed. Of the almost 405,000 cars made in Australia in 2004, some 47 per cent were manufactured in South Australia at the General Motors Holden and Mitsubishi plants. Both companies have a strong export focus. Supporting the two assemblers is a vibrant automotive components industry. There is a 90-hectare automotive precinct at Edinburgh Parks, north of Adelaide, with automotive component manufacturers located in the park directly linked by a tugger way to the Holden vehicle assembly plant.

Companies having established within the park, or in the process of doing so, include: Air International, Australian Arrow, Exacto Plastics, Plexicor, Toll Automotive Logistics, Hirotec, Dana, Cubic Pacific, Johnson Controls, Automated Solutions, Priority Engineering and Orbseal. Other South Australian-based companies, include: Bridgestone, BSTG Australia, Exide Technologies Manufacturing, Holden Ltd (subsidiary of General Motors), Tenneco Automotive, Mitsubishi Motors Australia, Schefenacker Vision Systems Australia, and TI Group Automotive Systems.

Despite the concentration of vehicle assembly in Victoria and South Australia, there are a number of other suppliers operating elsewhere. Bishop Technology, based in **New South Wales**, is one example. Bishop Technology Group operates through three operating companies: Bishop Innovation—a technology house that develops and commercialises products and processes; Bishop Manufacturing Technology—a world class machine tool designer and supplier manufacturing solutions for customers in automotive, aerospace, defence, biomedical and telecommunications industries; and Bishop Steering Technology—a leader in automotive steering gear technology innovation, with 20 per cent of all passenger cars produced globally each year incorporating some element of Bishop steering technology.

## Communications

While it was severely affected by the recent downturn in telecommunications investment worldwide, communications remains a significant area of opportunity for suppliers. Australia's electronics manufacturers exhibit particular strengths in mobile communications, photonics and opto-electronics, supported by excellent design, software and engineering services.

ICT equipment manufacturing activities as a whole have not developed as strongly as the local or world markets, but there are significant pockets of activity exhibiting world class capabilities. ICT equipment manufacturing income reached \$5.6 billion in 2002-03, with telecommunications, broadcasting and transceiving equipment accounting for more than \$1.7 billion, or almost 30 per cent. Australian exports of communications equipment have been affected by the global “dot com” phenomenon, with local exports well in excess of \$1 billion during 2000 falling to \$530 million in 2003. The recovery in communications investments saw Australia's communications equipment exports grow to \$600 million in 2004. During 2004, 50 per cent of Australia's communications equipment exports came from Victoria, 32 per cent from New South Wales and 9 per cent from Western Australia<sup>15</sup>.

**Victoria's** telecommunications industry has a turnover of almost \$10 billion, employs 20,000 people and has one of the largest R&D clusters in the Asia Pacific (including Telstra, NEC, Fujitsu, Siemens, Nortel Networks, Agilent and Bandspeed). The industry produces software and services for both fixed and wireless networks. One of Australia's largest spenders on ICT R&D, Telstra Research Laboratories, is headquartered in Melbourne, and the State accounts for 36 per cent of Australia's private sector ICT R&D. Specialist ICT manufacturing in Victoria includes the design and manufacture of niche hardware and equipment such as printers, modems, touch-screen kiosks and semiconductors. Victoria has a number of international corporations with niche telecommunications, chip design or R&D facilities. Communications and IT suppliers include: Siemens, NEC, Extel, Halipex, G&D, VPI Systems, Diamond Australia, RFS, CEOS, CommTel, InterCel, Cablex, Iplex (Volante), Aegis, Alfatron and a number of others.

- *Siemens Australia* provides a wide range of products and services in electronics, electrical engineering and ICTs, delivering solutions to information and communications, automation and control, power, transportation and medical markets, as well as components and financial services. In 2002, Siemens Australia's sales were close to \$1.2 billion, and Siemens employed around 2,900 people in Australia and New Zealand.
- *NEC* offers a wide variety of notebooks, desktops and PC servers. NEC also designs, develops and manufactures an extensive range of communications products from satellite earth stations,

microwave radio, PABX, routers, broadband DSL, mobile telephones and networks, mobile satellite telephones and networks, to fibre optics equipment. NEC recently invested \$70 million in establishing a 3G R&D centre in Melbourne, and invests more than \$10 million a year in R&D locally.

- *Extel Communications* supplies a range of access network solutions, encompassing pair gain systems, ISDN extenders and solutions for expanding DSL coverage. Extel solutions connect more than half a million subscribers in 14 countries. The company has continually upgraded its manufacturing facility to improve quality, efficiency and cost competitiveness. Extel's manufacturing capabilities include: multi-layer printed circuit board assembly using convection and vapour phase technologies; surface mount assembly capability; in-circuit testing using 'bed of nails' test sets; and computer controlled functional testing. Extel also provides contract manufacturing services to external customers.
- *Halipex* designs and makes optical access devices for telecommunications carriers that are used to connect customers to the optical fibre backbone.
- *G&D (Giesecke & Devrient Australasia)*, a fully owned subsidiary of Giesecke & Devrient in Germany, has established a full scale smartcard manufacturing facility in Melbourne where it produces SIM cards for GSM mobile phones and cards for pre-paid telecommunications. G&D also provides packaging and fulfilment services.
- *VPI Systems* provides network optimisation software that enables service providers to generate more

revenue from their existing networks and to reduce capital expenditures. Major corporations using VPI software included: AT&T, MCI, Sprint, Deutsche Telekom, Alcatel, Cisco, Fujitsu, JDS Uniphase, Lucent and Siemens.

- *Diamond Australia* offers a range of products for fibre optic networks, specialising in custom made products. Diamond operates one of the largest production facility for fibre optic connectors in Australia. Customers include: Telstra, Nortel, Siemens, Defence Material Organisation, BAE Systems, Agilent, Altamar Networks and Marconi. Diamond manufactures the bulk of its products locally to ensure quick turnaround.
- *RFS (Radio Frequency Systems)* is a designer, manufacturer, supplier and installer of wireless solutions and radio frequency sub-systems. For defence RFS designs, manufactures and installs a range of communication antennas for HF, VHF, UHF and microwave frequencies.
- *CEOS* arose from the University of Melbourne's Photonics Research Laboratory, and focuses primarily on broadband telecommunications, opto-electronics and design services. A recent partnering deal with Hitachi focuses on the development and application of Passive Optical Network technology for the delivery of high-speed broadband to the home or business (See Box).
- *CommTel Network Solutions* provides design, engineering and integration services for telecommunications systems based on the application of new and advanced optical fibre transmission technologies, including photonics, to the power utility, oil and gas,

transport and emerging communication carrier markets.

- *InterCEL* is a supplier of GSM/GPRS cellular data solutions in the Australian market. InterCEL supplies the full range of Wavecom products as well as its own in-house designed modems and CTS Solutions. InterCEL offers services to end users who require automated meter reading, fleet management and in-vehicle solutions, security monitoring and SMS gateway hardware.
- *Interworld Electronics* offers a range of reliable industrial rack mount computers, computer telephony and application software, data acquisition hardware and data communications hardware.
- *Cablex* is a specialist manufacturer of wiring looms, harnesses and fibre optic terminals, and offers a range of telecommunications, defence, electronic, automotive and whitegoods wiring looms.

One area of considerable promise now emerging in Victoria is fibre-to-the-home (FTTH), which opens up a huge opportunity for photonics and optical fibre, and a wide range of related electronics. A number of local groups are forming around FTTH, including CommTel, CEOS, Broadband Networks and Hitachi—with CEOS and Hitachi, and Telstra and Alcatel cooperating on projects (See box).

### CEOS

Since it was incorporated in 1994, CEOS has become recognised as an innovator in the fields of optical communications, fibre-to-the-home (FTTH) and PON technology, and non-invasive vehicle traffic analysis. CEOS has experienced personnel with expertise in: opto-electronics and photonics technologies; broadband electronic technologies; digital control electronics; analogue electronics; software and device modelling. CEOS has established the REDlab Test Facility, a laboratory that is suitable for the development of broadband telecommunications and opto-electronics products. CEOS has also established the Collaborative Optical Leading Testbed (COLT), a project providing the latest broadband services to homes, businesses, educational institutions and healthcare facilities in Ballarat, Victoria. COLT involves the rollout of optical fibre to the premises and it utilises a Passive Optical Network (PON) product deployed by CEOS. COLT is a unique collaboration between international leaders including Cisco, Intel, Corning and Agilent as well as numerous Victorian organisations. COLT provides services including high speed data and internet access, multiple voice lines, video on demand, interactive TV/home entertainment, video conferencing and telemedicine applications including large image transfer for real-time diagnosis.

Source: <http://unsw.innovationxchange.com.au/profiles/00000000383.html>

**New South Wales** is a significant centre of IT and communications industry activities. Value added by NSW-based ICT companies in 2002–03 was just under \$13 billion, 40 per cent of the Australian total. NSW companies had capital expenditure of \$2.6 billion in 2002–03, mostly in telecommunication services (\$1.7 billion). Of the 10 universities in NSW, about half are engaged in leading-edge ICT research, including internet and wireless technologies, laser and photonics, telecommunications, nanotechnology, smart manufacturing and quantum computing. In 2003, there were almost 20,000 IT students in NSW universities, around 40 per cent of which were from overseas.

The Australian Technology Park (ATP) in Sydney is headquarters for the ICT Centre of Excellence. The centre's 400 staff focus on research into infrastructure technologies, intelligent systems, software engineering, human-machine interaction and foundational theories and algorithms. In the private sector, Avaya, Citect, Citrix Systems Australasia R&D, and Lucent Technologies, all have significant research and development centres in Sydney. Just south of Sydney, the University of Wollongong has R&D alliances with a number of international companies<sup>16</sup>.

## COMMUNICATIONS RELATED COOPERATIVE RESEARCH CENTRES (CRCs)

*The Australian Photonics CRC* is a joint venture of five universities, TAFE, DSTO and over 20 industry partners. Its objectives include world-class research in photonics and optical technologies, commercialisation, education and training.

*The Australian Telecommunications CRC (ATcrc)* was established to provide a cooperative environment for developing and commercialising the technologies that will drive a new generation of telecommunications. ATcrc offers a unique set of research and development capabilities in networking and mobile telecommunications. Through education and training programs, ATcrc transfers expertise in technologies such as digital radio, packet networking, digital signal processing, and electronic design into Australian industry.

*The Satellite Systems CRC* is a joint venture of four Australian companies, six universities and two government agencies. It was established in 1998. The Centre carries out research and development, education, training, operations and commercial activities relating to space technologies, particularly in the field of low-cost satellite missions. Its first major project was the scientific and engineering satellite, FedSat, launched in December 2002.

*The CRC for Sensor Signal and Information Processing (CSSIP)* was established in 1992. Signal and information processing is multi-disciplinary and is essential in many of the systems that form the basis of modern technology. It involves engineers, mathematicians, computer scientists and physicists and has applications in many areas, such as communications, radar, sonar, acoustics, remote sensing, surveillance and imaging systems.

Source: CRC websites.

Leading producers include *Standard Communications (GME)*, an Australian owned company that manufactures quality products for radiocommunications, marine electronics, telemetry and data radio equipment and television signal processing and distribution. *CiSRA (Canon Information Systems Research Australia)* is a dynamic R&D company developing advanced technology solutions with a strong commitment to innovative and business-driven research. Established in 1990, CiSRA is the Australian R&D Centre for Canon. Its business focuses on: researching advanced technologies for Canon's future businesses; applying new technologies in Canon's business and consumer products; and developing

and licensing technology solutions for Canon and other clients.

**Queensland** has a thriving information and communication technology (ICT) industry with an emphasis on software development. The Queensland electronics industry has achieved strong growth in employment, turnover and exports in the last decade, with growing demand for niche or boutique product lines particularly in telephony, photonics, power supplies and monitoring systems. These product lines are usually innovative, have small production runs, or use proven equipment or expertise in an innovative way.

A number of **South Australian** electronics firms also serve the communications market, with local strengths in systems from 3MHz to microwave for voice, fax and data. Adelaide is home to Australia's advanced broadband consortium, *m.Net Corporation*, which offers both mobile infrastructure and a test-bed for application developers, content creators and researchers to trial new mobile services. Adelaide was the first city in Australia to launch a third generation (3G) telecommunications network and one of the first cities in the world to offer a public wireless local area network (WLAN) covering entire city streets. Recently, construction has commenced on the South Australian Broadband Research and Education Network (SABRENet), an 80 kilometre, high-speed fibre optic cable that will link every university, most hospitals and every research institution across greater Adelaide. Communications leads South Australia's electronics capability list, with local capabilities evident in mobile, fixed wireless and satellite telecommunications systems, radio frequency communication systems, signal processing and a wide spectrum of precision laser and opto-electronics. Local producer *Codan* (Codan Broadcast and IMP Printed Circuits) is an international leader in the provision of sophisticated remote area communication equipment and systems, with market in more than 150 countries. It is involved in the design, manufacture and support of HF radio, satellite and microwave links products.

## Defence / Aerospace (including Avionics)

The defence and aerospace industry is an important market for many Australian electronics firms, and one in which there are significant strengths. The value of electronics in defence-related activities is high, with electronics representing up to 80 per cent of the production cost of a modern war ship or a submarine. Overall, an estimated 30 per cent to 40 per cent of the value of military capital equipment expenditure can be attributed to acquisition or upgrades of primary electronic systems, and between 15 per cent and 20 per cent to the acquisition or upgrades of secondary systems.

Electronic systems that are critical to the Australian Defence Force include secondary and tertiary military systems integration, mobile military communications, electronic warfare, and niche capabilities in radar and underwater acoustic technologies. These are supported by national R&D capabilities in enabling technologies, such as photonics, monolithic microwave integrated circuits, artificial intelligence, electro-optics, radio frequency engineering, radar technologies, data fusion, safety critical software systems, and space-based communications<sup>18</sup>.

The military systems integration market in Australia is served by 12 dominant players and some 30 highly specialised small-to-medium enterprises (SMEs). The top 12 firms account for about 80 per cent of the work.

## EXPERTISE IN RADAR

Australia's vast maritime and air approaches pose unique challenges for surveillance. These challenges are accentuated by the small resource base and low density of fixed surveillance infrastructure relative to that found in North America or Europe. Low-cost technologies for long-range surveillance are, therefore, of great strategic importance to Australia.

Australia pioneered the development of very long range, ionosphere-reflected radar to address this need, and has carried this technology through into operational service with Jindalee Operational Radar Network (JORN). Australia has also joined the development of surface wave radar, which can fill the intermediate range for over-the-horizon surveillance. These two technologies offer powerful surveillance capabilities unmatched by other ground-based radars and at costs significantly lower than airborne or space-based sensors.

Australia has also established an indigenous capability in the development of active phased array radar for tactical applications. This technology has pervasive application across most military platforms, offering major advantages over conventional tactical radars in cost, effectiveness and scalability.

Source: DMO (2004) *Defence Electronics Systems Sector Plan*, Defence Materials Organisation, Canberra.  
Available [http://www.defence.gov.au/dmo/id/Electronic\\_Sector\\_Plan.pdf](http://www.defence.gov.au/dmo/id/Electronic_Sector_Plan.pdf) accessed April 2005.

They include: ADI, ASPECT Computing/KAZ (Telstra), BAE Systems, Boeing, CEA Technologies, CSC, Lockheed Martin, Raytheon, RLM Systems, SAAB Systems, Tenix and Thales Underwater Systems.

Medium-sized Australian enterprises prominent in primary systems development and integration include such firms as CEA Technologies (including but not limited to, active phased array radar) and Nautronix (underwater technologies). Smaller sized enterprises play an important role in supplying to the big 12 as subcontractors and in contracting directly to Defence on minor projects. These enterprises include such firms as Acacia Research (data fusion), Cirrus Real Time Processing (sonar and communications) and Daronmont Technologies (surface wave phased array), to name just a few<sup>19</sup>.

**New South Wales** companies supply a range of specialised components, equipment and maintenance services to defence—including communications intelligence and computing technology; defence products such as flight simulators and decompression chambers; airframe and systems support; software, sensors and processors; shipbuilding and ship repair; sophisticated electronics and logistics support; and sonar systems. Major firms supplying the defence and aerospace markets include: Australian Defence Services, BAE, Boeing, Eurocopter, Goodrich, Hawker de Havilland, Qantas, Tenix, Thales Group and Turbomeca.

## CODARRA ADVANCED SYSTEMS

Codarra Advanced Systems is a private firm with over 60 staff, headquartered in Canberra. Founded in 1990, it is primarily a technology and management consulting company working in communications, information technology and military systems.

Codarra's main skills lie in communications engineering, IT systems, project management, systems integration, security engineering, logistics and maintenance support. The main market for the company has been in defence and government. Searching for a way to differentiate itself from competitors, Codarra developed an uninhabited aerial vehicle to demonstrate its technical capabilities. In 2001, the firm launched the AVATAR Uninhabited Aerial Vehicle. AVATAR is a completely electrical tactical mobile reconnaissance vehicle that can be used for a range of surveillance and monitoring applications in defence, environmental monitoring, search and rescue, disaster management, policing and security, stock and station control, and land management. It can be launched from an unprepared site, and because it is electric powered it is very quiet and virtually undetectable from the ground.

AVATAR has brought Codarra into the ranks of systems designers and assemblers and has demonstrated its skill in the integration of a range of complex technologies. It is now seeking export markets and has been invited to provide demonstrations to governments in a number of countries.

Source: Thorburn, L. (2003) *Capitalising on the strengths of the ACT electronics industry*, Business ACT, Canberra.

The Canberra Region (**Australian Capital Territory**) also has a significant concentration of defence knowledge and expertise. Local industry capabilities include: intelligence support; high technology communications; intelligence systems; logistics and command and control systems; and specialist operations and warfare componentry. There are many large and small companies and defence contractors that compete for, and service Canberra's large defence contracts. These include: Raytheon (which established its South East Asian headquarters in Canberra), Electro Optic Systems (EOS), The Distillery, CEA Technologies, ATI, Compucat, and ASI Solutions.

In **Queensland**, the defence/aerospace industry is a potent driver in the growth of the electronics industry, principally through the manufacture,

maintenance and modification of avionic equipment for commercial, general, and defence aerospace sectors. The establishment of firms such as Boeing, QANTAS, Virgin, National Jet, Australian Airlines, Alliance, EADS, and Smiths in Queensland has provided the electronics industry with opportunities in all aerospace sectors. Major defence opportunities include: the outsourcing of F-111 maintenance and modifications at RAAF Amberley; relocation of the Australian Defence Force (ADF) Helicopter School to Oakey; the planned relocation of the RAAF Air Lift Group fleet to Amberley around 2010; and modifications to RAAF Air Lift aircraft (C-130 Hercules) in progress at Amberley. The Lockheed Martin F35 Joint Strike Fighter (JSF) has been selected to replace the F-111 and F/A-18 fleets in 2014, providing further potential opportunities for both

electronics and aerospace companies capable of manufacturing equipment to the highest quality standards. Other Defence acquisition projects such as the construction by EADS of the new Tiger armed reconnaissance and civilian helicopters at Brisbane Airport, and rationalisation of the ADF helicopter fleet, also offer opportunities to build on the foundations already laid. Queensland is home to such companies as *Micreco*, which has an experienced team of engineering and production staff with proven track records in the development and manufacture of both microwave-electronic and photonic products for commercial and aerospace applications.

Defence is also a major sector of the **South Australian** economy, contributing more than \$1 billion to Gross State Product in 2002-03.

Breakthrough research and development from the Defence Science & Technology Organisation (DSTO) and a cluster of innovative small and medium-sized enterprises provided a strong attraction for the many multi-national companies that have set up in Adelaide. These companies include BAE Systems, ASC, SAAB Systems, Tenix Defence, Raytheon Systems, and General Dynamics Land Systems. Local electronics firms have long established and deep linkages with the defence industry. The local Defence Electronics Systems Cluster involves a group of SMEs that span a wide range of activities, from electronics to surveillance and reconnaissance, command and control systems, systems engineering and integration, testing and evaluation, and modelling and simulation.

## Scientific instruments and medical devices

While relatively small and fragmented, the medical and scientific devices area has a strong user base in Australia and some leading-edge production capabilities. There is some overlap in markets for medical and scientific equipment, and many firms manufacture for both markets. Nevertheless, there are some significant differences. The medical equipment market is highly concentrated in the health care, medical, surgical, hospital, first aid and special and aged care marketplace. Scientific equipment is sold into that market too, but also covers many other areas, such as the education, research, biotechnology, mining, defence and petrochemical sectors, and most manufacturing industries<sup>20</sup>. The main market drivers in the medical and scientific equipment segments are government and private spending on health services, medical and scientific research, and the development of new technologies.

Strong increases in R&D expenditure around the world drive increasing demand for **scientific instruments** and, with increasing knowledge intensity in economic and social activities, that trend is likely to continue. During 2002–03, professional and scientific equipment manufacturing industry income reached almost \$1.3 billion in Australia, having grown rapidly from \$502 million in 1995–96. A recent survey found that manufacturers in the science industry invested an average of 8 per cent of their sales on R&D, around five times Australia's manufacturing industry's average<sup>21</sup>. Education levels are high, with nearly 50 per cent of staff having at least a bachelor degree. Exports averaged 25 per cent of sales, with a few larger companies exporting up to 90 per cent of their production

### COCHLEAR LIMITED

Twenty years ago Professor Graeme Clark, in his groundbreaking research launched the world's first commercial multichannel cochlear implant. Since the first commercial implant, Cochlear's award-winning Nucleus range has been implanted in nearly 62,000 people worldwide. Cochlear is the world leader in cochlear implants, which have enabled tens of thousands of severe to profoundly hearing-impaired people to hear.

Cochlear operates in a global niche market, with 80 per cent share of the market in Asia-Pacific, 60 per cent market share in the Americas and approximately 60 per cent market share in Europe. Cochlear continues to expand its export base. Cochlear employs over 800 people, 450 of them in Australia, with head office, manufacturing and the majority of R&D remaining in Australia—although some R&D is undertaken on Europe and the US. There are also regional offices in the US, UK, France, Belgium, Switzerland, Germany, Japan and Hong Kong.

Cochlear is a significant investor in R&D, with \$44.5 million spent on R&D in 2004, a 7 per cent increase from the previous year—reflecting acceleration in the development of new generation technology. Cochlear's extensive research program involves clinics all over the world, it provides significant opportunity for Cochlear to leverage the latest technology research for future products. The collaboration is also a critical part of the developing relationship with major implant professionals. Cochlear's research efforts are closely linked to those of the Bionic Ear Institute, University of Melbourne and the Cooperative Research Centre for Cochlear Implants and Hearing Innovation.

Source: DITR (2005) *Medical Devices Action Agenda Discussion Paper*, Department of Industry Tourism and Resources, Canberra.

(mainly scientific instruments and clinical diagnostic reagents). Growth prospects are excellent.

Global, and domestic, demand for **medical devices** is driven by the increasing affluence of developed and many developing countries, higher expectations regarding quality of life and extension of average life expectancy, and the world's current health care challenges, such as meeting the health needs in developing countries. The convergence of technologies is also providing new devices. Australia is well-positioned to increase its productivity to meet growing demand.

The medical devices sector is growing rapidly with increasing employment of skilled staff. Australian businesses have shown that they can take products to the world and generate new markets, as ResMed did in educating physicians about obstructive airway disease and Cochlear did with hearing implants.

Recent electronics industry mapping activities uncovered local scientific and medical equipment related capabilities in Victoria, Queensland, South Australia and the Australian Capital Territory.

## SEEING MACHINES

Seeing Machines is at the forefront of developing 'intelligent vehicles' with lane departure warning, driver fatigue warning systems, and automatic lane-following functions. An 'adaptive cruise control' combines the function of standard cruise control with an inbuilt sensor to drop the speed if there is a slower vehicle in front. The next stage of Professor Zelinsky's work involves the development of active safety devices such as sensors that detect pedestrians and prevent the vehicle from making contact with them.

Seeing Machine's flagship product 'faceLAB™' is a turn-key system for laboratory and simulator studies of face and gaze tracking. FaceLab registers even the tiniest of eye movements that betray driver fatigue or distraction, and is used not only to develop driver warning systems, but also to intercept car design problems before they reach the road. As well as being adopted by Volvo, this human performance monitoring device has been bought by automotive and electronics giants Bosch, DaimlerChrysler, Mitsubishi, Motorola, Nissan and Toyota.

Source: <http://www.stroudgate.net/innovation/articles/article.php?id=3,042>

In **Victoria**, leading medical devices suppliers include: Compumedics, GBC, Medtron, Norwood Abbey, Varian and Vision Systems (BioSystems). Victoria's instrumentation suppliers include: Agilent Technologies, Alfa-Tek, Contrec, Datataker, Gedge, Hawk Measurement, Kingfisher, McVan, Phasefale and others.

- *Compumedics* produces computer-based medical monitoring and diagnostic equipment. Its products for sleep disorders are world-leading, and the majority of Compumedics' income is from export sales.
- *GBC Scientific Equipment* is one of the largest Australian-owned designers and manufacturers of analytical scientific equipment, employing more than 100 people and selling to more than 100 countries. GBC derives 90 per cent to 95 per cent of its income from exports.

- *Norwood Abbey* was established in 1998 to develop and commercialise medical laser technologies based on electromagnetic and mechanical energy. A major focus is drug delivery. Norwood employs 23 people and earned consolidated revenue of \$436 million during 2003.
- *Varian* generates the majority of its income from professional and scientific equipment manufacturing, realising around \$125 million in revenue during 2003 and employing 425 people. Varian invested more than \$10 million in R&D during 2001-02.
- *Vision Systems* is a locally owned company that focuses on electronic equipment manufacturing. In 2003, Vision Systems generated some \$130 million from sales, of which Vision BioSystems realised around \$30 million. Vision Systems invested almost \$6.5 million in R&D during 2001-02.

There are many other firms also operating in these markets.

In **South Australia**, electronics firms exhibited local strengths in medical and scientific, telemedicine systems, laser systems for ophthalmic surgery and skin treatment. Local suppliers of scientific equipment include: Adelab Scientific, Advanced Rapid Robotic Manufacturing, Analytical Equipment, Austofix, Bio-Tech Electronic Services, Blue Sky Scientific, Coherent Scientific, Crown Scientific, Ellex Medical Lasers, High-Tech Instrument Services, Lastek, Micronix, Millennium Sciences, Noseld, OSMOFLO, Scan Optics, SMC and Vision Instruments.

In the **Australian Capital Territory**, local manufacture of medical equipment is limited, but test and measurement and other scientific equipment are the focus of strong local supply into the region's major research institutions. Local suppliers included: Accuweigh, Australian Scientific Instruments, Canberra Machining Company, Dynjab Technologies, GPSports Systems, QWM Weighing Technology, Seeing Machines (see box), Sentinel, Simplex Canberra and Wedderburn.

In **Queensland**, there are also a number of leading scientific and medical equipment companies, such as *Crystalaid*, *Intellidesign* and university-based research groups at Griffith University, University of Queensland and Queensland University of Technology, whose activities encompass the design, development and manufacture of electronic, microelectronic, bionic and bio-medical products for the medical market.

## Other sectors

As might be expected, Australia's electronics firms have developed significant strengths in specialist areas serving the vertical markets in which Australia itself has strengths, such as: mining and agriculture, transport and marine, building and construction and a range of applications specific to one or more of these major sectors (e.g. sensing and environment monitoring). There are many hundreds of examples, but the following give a sense of these niche capabilities.

### Mining

*Minelab*, based in **South Australia**, has sought to become the world leader in metal sensing technology. Specialising in advanced electronic technologies, Minelab's competitive advantage was created almost immediately through innovative R&D. More recently, Minelab has expanded its scope of excellence to high-end audio electronics with the design, development and marketing of the cutting edge HALCRO range of sophisticated audio amplification equipment. Today, Minelab has manufacturing, distribution and customer service operations in Australia, Europe and the United States, and is an ISO 9001 Quality Endorsed Company<sup>23</sup>.

*I-SiTE* Pty Limited was founded in 1999, also in South Australia, following development work within Maptek, an international company which develops and distributes VULCAN, the world's leading 3D mine planning and modelling software. I-SiTE develops and supplies 3D laser imaging products worldwide.

It provides a total solution for the laser imaging market by developing new software technology, integrating new hardware development and providing support and professional services globally<sup>24</sup>. The I-SiTE 4400 laser scanning system was recently purchased by Peabody Energy, one of the world's largest coal companies and an innovative, growing, low-cost energy provider, with 2004 sales of 227 million tons and USD 3.6 billion in revenue. Peabody Energy operated three of the four most productive mines in North America in 2004. Their North Antelope Rochelle Mine (North America's biggest coal mine) purchased the I-SiTE 4400 integrated surveying system to help measure the volume of cast blasts more efficiently<sup>25</sup>.

### Agriculture

A number of **South Australian** electronics firms serve the local food and wine industry, with such things as irrigation controls for vineyards and process control systems for food and wine production.

One firm, *KEE Technologies*, develops and manufactures innovative electronic control solutions for agricultural machinery. KEE has been involved with the emerging 'Precision Farming' trend since the adoption of Global Positioning Systems (GPS) in agriculture in the mid 1990's, and has developed the ZYNX platform and software to meet the needs of this emerging market. The KEE product range includes interactive control systems for use in harvester monitoring, seeding and spraying. These products are suited to a diverse crop application covering horticulture as well as broad-acre farming.

The recent development of data logging capability in the KEE product range provides farmers with an electronic record of all activities, coupled with the opportunity to preset the control systems to ensure best practice is achieved. Through strategic alliances with three major companies that produce auto steering products, the company can now offer a fully integrated system that can deliver hands-free operation for the operator—the true auto-pilot for the land<sup>26</sup>.

For over 25 years, **Western Australian** firm *Farmscan* has helped Australian farmers to become the world's most efficient grain producers by providing a complete range of electronics to monitor and control spraying, spreading, planting and harvesting machinery. In 2001, the company acquired Precision Farming Australia, a successful Australian company that developed Farmlap GPS guidance and auto-steering technology. The resulting pool of talent now involved with design, manufacture and support of Farmscan products can provide farmers and contractors with a completely integrated range of agricultural electronics. Farmscan products are also gaining international recognition, and with expanding operations in Europe, Canada, and South Africa, the company now employs over 75 people in product design, manufacture and customer support services<sup>27</sup>.

**Queensland**-based *Vortex* serves this industry and there is strong development activity in CSIRO's facilities in Pinjarra Hills.

## Transport

Australia was a pioneer in developing intelligent transport systems (ITS), such as the Brisbane Linked Intersection Signal System (BLISS) and the Sydney Coordinated Adaptive Traffic Control System (SCATS) which is now used widely overseas. Private sector use of ITS in Australia is currently focused on freight/logistics and fleet management, such as the taxi industry and motoring associations' roadside assistance. Consumer use of ITS is still relatively small, but it is expected to be a major growth area of the future (e.g. through safety and navigation applications in cars).

Some examples of ITS applications currently operating in Australia, include: adaptive traffic control systems, to provide priority for road-based public transport vehicles; freeway management and information systems, to reduce delays due to traffic incidents; electronic fare collection systems, to improve the convenience of public transport travel and reduce system costs; electronic tolling; in vehicle navigation and information systems, to assist drivers and reduce unnecessary travel; vehicle location and scheduling systems, to reduce theft, improve roadside service, and improve efficiency of freight movement; and advanced traveller information systems, to improve user's understanding and efficiency of use of public transport systems. In addition, there are several ITS trials currently being conducted on Vehicle Collision Avoidance Systems, Remote Vehicle Guidance Systems and Automated Highway Systems<sup>28</sup>.

**ERG**, a **Western Australian** company employing 900 people in 11 countries, is a world leader in the development and supply of integrated fare management and software systems for the transit industry and smartcard systems and services. The Group has installed systems in major cities throughout the world, including: Hong Kong, Melbourne, Rome, San Francisco and Singapore with installations in progress in Gothenburg, Seattle, Stockholm, Sydney and Washington DC. ERG has delivered systems that support more than 20 million smart cards in circulation and handle approximately five billion transactions per annum<sup>29</sup>.

**Nautronix**, also based in Western Australia, is a leader in Through Water Communications and Positioning Technology. Nautronix is committed to the protection of the environment. By using renewable resources wherever possible, and developing manufacturing processes and procedures, Nautronix ensures adverse effects on the environment are reduced to a minimum<sup>30</sup>.

**Victoria's Raywood** is a pioneer in wireless dispatch solutions, GPS vehicle location systems and in-vehicle security systems for the transport and logistics industry. In 1995, Raywood was one of the first in the world to incorporate Global Positioning System (GPS) technology into a computerised job dispatch solution to optimise the tracking and dispatching of large fleets of vehicles. This solution revolutionised the taxi industry and is in use in hundreds of fleets worldwide. Raywood also led the way in the production of in-vehicle digital security cameras. These cameras are now installed in tens of thousands vehicles worldwide. Raywood's next generation dispatch solution employs the latest advances in

software, hardware and networks, such as Windows-based MDTs, public data networks (CDMA, GPRS, 3G) and cost-effective navigation solutions, to provide the next 'leap forward' for the industry<sup>31</sup>.

## Marine

Australia's marine industry includes ship and boat builders and repairers, marine equipment manufacturing and many related activities. The industry employs over 19,000 people and has a turnover in excess of \$4 billion per year. It is a major employer in some regional areas of Australia. Electronics and communications are increasingly important, and there are many Australian firms supplying niche electronics and communications products for demanding marine applications. Activities are widespread, with particular strengths in fast ferry and related defence construction in **Western Australia** and **Tasmania**, defence-related ship and submarine construction in **South Australia** and leisure craft boat building activities in **Queensland** and **New South Wales**. Each is supported by local marine-related electronics suppliers.

One example is **Standard Communications (GME)**, which has been at the vanguard of marine electronics in Australia since the early 1970s. The combination of hands-on experience with creative software engineering has produced a host of innovative GME Marine products, including the world's first VHF transceiver with totally integrated direct dial telephone facility, the compact COSPAS/SARSAT compatible EPIRBs, and the GR series of marine stereos. All GME marine products undergo stringent testing to ensure they will provide years of trouble-free service in the harsh marine environment.

## **Building and Construction**

There are many points at which the electronics industry links to building and construction activities. One particular local strength is in the 'intelligent home', which combines a wide range of home automation, connectivity, wireless networking, entertainment, energy and water conservation, and information access applications. The inaugural Intelligent Home Show held in 2004 attracted well over 100 industry exhibitors involved in home automation.

*Clipsal Integrated Systems* provides products that make working and home lives more comfortable, safer and energy efficient. The launch of the Clipsal C-Bus Energy Management System in 1994 marked a new direction, with many Australian and international building projects benefiting from the convenience and energy savings that it provides.

Clipsal also offers a number of other building automation systems, such as the Clipsal Home Minder Home Automation System, and the 5 Star Room Control System—a system that provides hotel guests with the optimum level of convenience and comfort, and hotel operators with significant energy savings<sup>32</sup>.

*HPM* employs more than 1,000 people operating from eight factories in Australia and two factories in New Zealand. HPM has a product for nearly every electrical application, manufacturing and distributing: powerpoints, light switches and dimmers; industrial connection and switching systems; safety earth leakage devices; ceiling exhaust fans; lighting; and sophisticated home and building automation systems. The range includes more than 7,000 products. Underpinning this diverse product range is a strong commitment to technology, R&D and quality<sup>33</sup>.

*The KRONE Group* of companies includes 30 subsidiaries around five continents. Founded in 1928, by Gustav KRONE, the KRONE Group headquarters are located in Germany. Incorporated in 1980, KRONE Australia has grown to become a dynamic \$60 million manufacturing and marketing organisation, highly successful in the fields of communications networks and power distribution. Total investment in KRONE's Australian R&D and manufacturing is in excess of \$60 million. On average, 30 new products have been produced by KRONE Australia every year since 1984. The company manufactures 90 per cent of all products sold in Australia using sophisticated plastic injection moulding, high speed metal stamping and fabrication, and computer-controlled automated assembly lines. These processes ensure that KRONE products are consistently manufactured to the highest quality standards<sup>34</sup>.

## APPLICATIONS

Strengths in particular technologies translate into applications, with local capabilities in the Australian electronics industry including such applications as telematics, security, home automation and networking, e-tag, e-toll and e-ticketing in transport, robotics and automation, as well as power electronics and remote sensing.

Cross-cutting technologies foster cross-fertilisation of applications and markets. Two recent examples are telematics, an example of ICT convergence impacting on a traditional industry, and smart building, where competitiveness for the private sector is maximised through the introduction of new technologies. Such developments have the capacity to stimulate new areas of activity. For example, telematics has the potential to stimulate the development of a new content. Australia needs to explore and maximise its potential in new 'niche' markets, based on its innovative capacity, in an environment that is globally-oriented, flexible and, most importantly, customer-centric. Short and customised manufacturing runs to provide a 'point of difference' based on innovative processes, rather than mass manufacturing, should characterise the 'new' Australian electronics industry.

Areas of opportunity that are emerging for Australia include the: development of new technological products and processes in emerging markets (e.g. telematics and smart building); localisation of international products for the domestic market; and customisation of Asian products for the western market. The pervasiveness of electronics implies a need to bring discrete technology-based sectors together into collaborative networks and clusters. The extent to which Australia is successful in achieving this will be a strong determinant of its global competitiveness in the next decade.

### Telematics

Telematics combines computing and wireless communications technologies to provide the capability to effectively convey information over networks. The term has evolved recently to encompass automobile systems that combine GPS tracking and other wireless communications. 'Intelligent home networking', focused at the consumer level, is also an emerging area of considerable interest to the telematics sector. A recent 'car of the future' project, involving up to 20 organisations, has produced the first telematics link from vehicle to home automation systems in Australia, arguably the first time this has been effected in the world.

One of the largest telematics companies in the world, Thales Telematics of the United Kingdom, noted that: "the world market for vehicle telematics and fleet management solutions for professional and consumer markets is estimated today at USD 5 billion, with annual growth rates forecasted at 50 per cent". The company also noted that around the world more than 20,000 vehicles a day are fitted with a telematics system<sup>35</sup>. The European market is projected to be in the order of USD 6 billion by 2006, represented by 2.3 per cent of the European car market (an estimated 40 per cent of cars will need to be fitted with telematics from the factory) or 11 per

cent of the current European mobile communications market. UBS Warburg predicted that global end user telematics revenue will approximate USD 48 billion by 2010<sup>36</sup>. It is expected that this growth will be driven by increasing traffic congestion, public concern for road safety, reducing costs of location technologies (e.g. GPS), maturing wireless networks better supporting new innovations, and a maturing automobile market. The European Union is particularly supportive of what it terms 'transport telematics'.

Whilst IPI in the United Kingdom noted that traditional telematics solutions remain "heavily dependent on proprietary technology and 'closed' communications infrastructure", it suggested that the "trend towards platform independent architectures, universal use of internet protocol-based networking and the adoption of ASP models" is driving a new paradigm in telematics applications. IPI also highlights the prediction of a number of independent experts that the sector will generate increasing revenues, based on the "high speed, broadband capabilities of so-called 2.5G and 3G telecommunications, the Internet and 'information enabled' homes and cars"<sup>37</sup>.

The current National Telematics Industry Initiative, with its multi-dimensional approach, provides a lead for opening up new application areas and fostering the development of the electronics and electronics enabled industries in Australia. The telematics demonstrator projects have proven to be a very effective tool for engaging companies wishing to enhance their current telematics business, through the expansion and development of new solutions. These companies not only wish to establish a foothold in the local market, but are also focused on the

export market for both OEM and after market solutions. Most of these companies have been operating in a very fragmented and isolated way and have embraced the Telematics Cluster initiative as a proactive initiative by which a sustainable and profitable telematics capability can be established in Australia.

A number of companies are now participating in demonstration projects, and forming strategic alliances with other companies in the cluster to produce saleable telematics solutions. All solutions are currently based on private and commercial vehicles, but as the telematics cluster continues to grow, and trust develops between participants, collaborative projects on other transport modes, including marine craft, are expected. The National Telematics Industry Initiative has already uncovered approximately 400 companies in the telematics value chain in Australia, and anecdotal evidence points to an even higher figure.

## Security

Security is an area with strong growth potential in an era of heightened domestic and international security concern and increasingly demanding regulatory oversight of fire hazards. 'Safeguarding Australia' is one of four national research priorities. In recognition of this, National ICT Australia (NICTA) has placed an emphasis on this sector, through the establishment of a Brisbane office dealing with anti-terrorism activities. There are also a number of fora and clusters in e-security which provide a mechanism for industry-led activities. These include the AEEMA-led Australian IT Security Forum (AITSF), and the E-Security Australia Cluster (based in Brisbane).

**Queensland** has considerable strengths, with approximately 190 companies involved in the e-security sector. The State's e-security companies export to every continent and have contracts and distribution networks into every aspect of the market. It is among the largest e-security communities in the Southern Hemisphere, with leading edge R&D infrastructure across a broad range of fields, including: threat and vulnerability assessment; security policy development; data encryption; secure communications and transactions; and forensics and intrusion detection. Typical of the State's R&D capability is the internationally-recognised Information Security Research Centre, specialising in the areas of cryptology, network and systems security, secure electronic commerce and security policy and risk management. AusCERT, the Australian Computer Emergency Response Team, is also based in Queensland.

In **Victoria** suppliers focussing on security applications include Interlogix (GE Security), Inner Range, Nidac, ACD Digital, Vision Systems (Fire and Security), and Intelligent Fire Systems. These, and other players focusing on security applications, represent a significant capability. In **South Australia** there are also electronics firms supplying safety and security systems, including video surveillance systems, with significant involvement in the defence industries.

## Home automation / Home networking

The Australian Electrical and Electronic Manufacturers' Association (AEEMA) has recognised an opportunity in the home automation/home networking field, and established the Connected Home Forum. The National Telematics Industry Initiative provides a link from the automobile to home automation/networking for the first time, via the involvement of Clipsal (see above). Innovations by such companies as Clipsal (also boasting an intelligent home in Melbourne), HPM, Blue Box Technology and IQ Home are leading the way in this emerging sector.

In **Queensland**, companies such as Broadband Systems are introducing plasma screen technology to shopping malls and other commercial centres; and local company, Spider Box, has introduced a range of services running over the same cable network.

In **Victoria**, the annual Intelligent Home Show presents the latest in home entertainment, smart home technologies and environmentally friendly smart sustainable solutions. It reflects a growing interest and capability in the area.

## Transport and logistics (incl. e-tag, e-toll, e-ticketing)

Transport authorities around Australia have been progressively introducing e-tag, e-toll and e-ticketing applications as important components of transport infrastructure. This is particularly so in **Victoria** and **New South Wales**, with **Queensland** also assuming a strong role in transport innovation.

Based in **Victoria**, ITS Australia (ITSA), is Australia's leading organisation supporting the development of a safe, efficient transport system which is responsive to the environment through the use of advanced technologies. ITSA promotes the use of advanced technologies to improve Australia's passenger and freight transport systems, through forums to guide the development and integration of these technologies, systems and standards. Currently a partner with AEEMA in the development of the National Telematics Industry Initiative, ITSA takes a lead role in promoting areas such as pre-crash technology, collision avoidance radar, automatic crash notification, drive by wire systems, and hands-free driving. Other innovations are also being promoted, such as fatigue monitoring, lane keeping, adaptive speed control, emergency alert systems, collision avoidance, vision enhancement and driver information systems.

Peak organisations, such as the Federation of Automotive Products Manufacturers, Federal Chamber of Automobile Industries (FCAI), and the Tooling Industry Federation of Australia (TIFA), play complementary roles in the development of transport infrastructure in Australia, as do large e-toll, e-tag and e-ticketing providers, such as: Transurban, RTA New South Wales, Tyco Traffic & Transportation, and Toll Holdings. Internationally, Australia is a regular participant at the annual World Congresses in Intelligent Transport Systems (e.g. Nagoya 2004).

In **Queensland**, the Brisbane City Council has introduced a city-wide traffic control system known as BLISS, whilst Main Roads, Queensland Transport (through ITSQ) and Queensland Rail are first-movers in traffic infrastructure innovations. There are a number of private sector practitioners in this area, including GPS Online, Tramanco, Webmap, McSoft, Hyperion Technology, Exceltech, RF Technologies Aust, Intellidesign, Sage Consultants and Transmax.

## Robotics / Automation

Both industrial process control and instrumentation are areas of strength and opportunity in **Victoria**. Industrial and Process Control suppliers include: ANCA, Datataker, IPC Global, Innovonics, Intermoco (Australon), Moonlighting, NeoProducts, Robotron, Traffic Technologies, Atco Controls, Schneider Electric, Bytecraft Automation, and many others. All contribute to local capabilities.

In **Queensland**, Advanced Robotic Technologies, Schneider Electric, Innotech, Climax Electric (process control), Rinstrum (process, batch control) and QMI solutions (rapid prototyping) also provide solutions in this area. Robotics and automation are widely used in the State's key sectors of agriculture and mining, and a strong R&D base is developing through CSIRO's work at the Centre for Advanced Technologies in the area of unmanned underground vehicles for exploration and mining.

Providing education in robotics and automation are institutions such as the Charles Sturt University in **New South Wales**, supported by the NSW Department of Education and Training (industrial technology/robotics) and private sector organisations such as Machinery Automation and Robotics. The TAFE sector also develops and delivers curricular in this area. In Western Australia, the University of Western Australia has a strong focus on robotics, as does the Western Australia Innovation Centre (Bamrico Laboratory Automation) through its commercialisation of 'labman' robots.

In **Tasmania**, Denning Branch International have produced a number of small robots for a range of applications, whilst in **South Australia**, the automation specialist Advanced Rapid Robotic Manufacturing (ARRM) recently released a new high-tech robotic product for medical research. A bench top instrument, it will dramatically speed up imaging and extraction techniques used in the pharmaceutical industries, both domestically and internationally.

## Power electronics

There is a large and growing market for a wide range of power supplies, and increasing focus on mobility, security and uninterruptible power supply. In addition, there is emerging interest in electric and hybrid vehicles, for which power supply technologies are crucial.

**Victorian** power electronics suppliers include: Arlec, Rectifier Technologies, Selectronic, Setec, Thycon and Thytac. CAP-XX Super Capacitors and Invensys (Eaton Electric) are active in **New South Wales**. In **Queensland**, Thew & McCann, ABB Transmission, EDMI as well as electricity authorities such as Ergon Energy and Energex, are playing a leading role in the development of power electronics. **South Australian** company REDARC provides power conversion products, and in **Western Australia**, Murdoch University is among those providing power engineering/power electronics education.

## Remote sensing

**Western Australia** has a ready supply of highly educated workers with acknowledged world-class skills in areas such as: wireless communications technology and products; remote area communications; mining remote sensing and spatial data software applications; and systems and applications software involving the use of ICT to enable strategic development in other sectors (e.g. oil and gas, mining, marine and defence). Private sector organisations playing a key role in this area include *Barrett Communications*.

*Mapinfo* and *ArcView* also play a leading role in remote sensing in Australia, as do *EM Solutions* and *Codan*. The latter company, based in **South Australia**, is the international leader in the design and manufacture of sophisticated high frequency radio, satellite and terrestrial digital microwave radio technology (see above). Australia also possesses capability in the area of micro-climate monitoring in agriculture (see above).

In **Queensland**, the CSIRO's Centre for Advanced Technologies has an interest in large-scale data mining and remote sensing in exploration and mining, whilst the Cooperative Research Centre in Satellite Systems is establishing a technological capability in the emerging GNSS navigation system, linked to the multi-billion dollar European Galileo satellite initiative. National ICT Australia (NICTA), in **New South Wales**, also has a research interest in this emerging area.

## TECHNOLOGIES

Fundamental technologies that provide the underlying infrastructure for the future electronics industry in Australia include: photonics and opto-electronics, chip-on-board and chip-on-glass manufacture, laser welding, flexible circuit board manufacture, microelectronics, nanotechnology and MEMS (Micro-Electro-Mechanical Systems, which is the integration of mechanical elements, sensors, actuators and electronics on a common silicon substrate through micro-fabrication technology). Australia has strengths in these areas, but there is a need to build up capacity in chip-on-board and chip-on-glass manufacture, laser welding and flexible circuit board manufacture to keep up with international manufacturing practices.

### Photonics and opto-electronics

Australia has well-developed capabilities in photonics, including internationally recognised research skills and a number of component and system developers<sup>38</sup>. The Australian Photonics Forum, operating through the Australian Electrical and Electronic Manufacturers' Association (AEEMA), maintains strong international links. It is a member of the International Coalition of Optoelectronic Industry Associations (ICOIA), is involved in the formulation and implementation of the AEEMA-Taiwan Strategic Framework Agreement, and is currently finalising an MOU with the Photonics Industry Development and Technology Association of Taiwan.

It is also linked, indirectly through AEEMA's MOUs, with kindred associations in China and Hong Kong (SAR), Korea, USA, Singapore and South Africa.

### THE PHOTONICS INDUSTRY ROADMAPPING PROJECT

The Photonics Industry Roadmapping project, supported by the Australian Photonics Forum, Australian Photonics Pty Ltd and Bandwidth Foundry Pty Ltd, was commenced in June 2004. The project had a twofold goal: to seek to understand the Australian photonics industry better together with its key competencies; and to match those with the emerging opportunities worldwide.

The Australian photonics industry, like the electronics industry as a whole, has a significant identity problem. Very few companies, although they may be very active in photonics development or manufacture identify with the photonics industry - rather they identify with the vertical industry segments that comprise their markets. Thus photonics should really be considered as an enabling technology for a huge array of industries. One of the key tasks of the project was to place the Australian industry in an international context against the seven photonics industry segments: Communications (principally over optical fibre); Input / Output devices (such as scanners, and imaging chips for digital cameras); Displays (including LCDs and Plasma TVs); Optical storage (including CDs and DVDs); Sensors; Energy (including solar cells); and Others (including Solid State Lighting and Lithography).

The photonics industry in Australia comprises approximately 100 companies located throughout the major centres. The project estimated that in 2003/4 the industry generated sales of nearly \$500 million. Apart from a number of defence integrators with photonics capability and BP Solar (a major manufacturer of solar cells), the industry is largely comprised of small-to-medium enterprises. This industry make-up creates some significant competitiveness challenges in the context of a hundred billion US dollar market internationally. Many of the market segments are mature and dominated by large corporations and increasing standardisation. Australia's opportunities lie in being nimble, and in finding niches appropriate to our skills and resources. The Photonics Industry Roadmapping project is targeted at providing some guidance for the industry in this regard.

Source: Dr Eric Heyde, Aduro Consulting

**Victoria's** photonics cluster features a diverse base of industry applications, vibrant companies, a real potential for significant business-to-business cooperation and excellent education and research capabilities. Early photonics activity in Victoria focused on telecommunications. Optical fibre research in Australia first started at Telstra Research Laboratories (TRL) in the early 1970s. The first fibre optic systems were deployed in Melbourne in the early 1980s, and the first national long haul fibre systems were deployed in 1986. Victoria's photonics cluster embraces activities in a number of areas with considerable prospects for growth, including: communications; medical; biophotonics and micro-photonics; defence and intelligent transport systems<sup>39</sup>.

Victorian-based *REDcentre* commenced operation in 1997, and operated in the period 1997-2000 with the assistance of an Australian Government Technology Support Centres program grant as a division of Australian Photonics Pty Ltd. REDcentre was in the business of technology diffusion, and successfully delivered technology assistance to 13 small and medium enterprises (SMEs), resulting in the creation of 55 jobs and \$25 million worth of exports.

In 2000, REDcentre became a private company, Redstart Pty Ltd (trading as REDcentre). It continued with technology diffusion, but added business diffusion and access to capital to its service offerings in response to demand from its SME customers. REDcentre has now assisted more than 100 SMEs with their technology, business and capital needs<sup>40</sup>.

In the **Australian Capital Territory**, the Photonics Institute was established to act as a technology development organisation focused on manufacturing. It is supported by The Australian National University, the University of Canberra, the Canberra Institute of Technology and the Australian Defence Force Academy, which provide the underlying R&D and educational infrastructure. In **Queensland**, one of the stand-out performers is *Micreo*, which is the only SME in Australia to be awarded a long-term agreement by the US Defence Department for the Joint Strike Fighter contract.

## Micro / Nano / MEMS

Microtechnology is the convergence of a multitude of technologies and disciplines—physics, chemistry, engineering, biotechnology, medicine, nanotechnology, materials science, microelectronics, lithography and ICT-deployed in structures and devices with features in the micron domain. While there is a strong research capacity in nanotechnology, particularly in Victoria, New South Wales, Western Australia and Queensland, private sector activity is not yet strong. Nanotechnology Australia, a private sector organisation, is promoting itself as a national hub in this sector.

Microtechnology is being developed within the Microtechnology CRC, with industry partners including: The Australian Sports Commission, Alcatel (Australia) Limited, Bioproperties (Australia) Pty Ltd, Cochlear Limited, MNT Innovations Pty Ltd, The Commonwealth Government's Defence Material Organisation, Queensland's Department of State Development, and Victoria's Department of Innovation Industry and Regional Development. The Microtechnology CRC, School of Microelectronics at Griffith University, and others in New South Wales and Victoria use international level design tools to design circuits in silicon.

R&D is being conducted within Griffith University, RMIT University, Swinburne University of Technology and the CSIRO's Manufacturing and Infrastructure Technology. Research focuses on fabrication technology, microdevice packaging and system integration, safety and health microsystems, and microfluid devices.

## Manufacturing technologies

Chip-on-board and chip-on-glass manufacturing, laser welding and flexible circuit board manufacture are crucial technologies for the future as electronics circuitry becomes integrated into its packaging.

Chip-on-board and chip-on-glass manufacturing technologies reduce component count, are based on solder (lead free applications) and allow for large scale integration of products. They also provide for the manufacture of cost-effective products which are more difficult to copy. For high-value, low-volume manufacture, it is a critical manufacturing base for the future, but there is little local capacity at the moment. Building such a capacity will require considerable investment in new manufacturing equipment. Lack of investment in this type of technology will restrict Australia to the utilisation of out-dated manufacturing techniques and equipment.

Laser welding encapsulates modern high-frequency, micro-size electronics. Organisations focussing on this area include: the Plastics Institute of Australia, QMI solutions (Queensland) and the Welding Institute of Australia. As for chip-on-board and chip-on-glass technology, this is a fledgling capability in Australia. At the moment, Australia does not have the ability to compete globally.

Internationally, the electronics industry is moving away from rigid circuit boards to flexible ones, to allow boards to be readily manufactured to fit virtual computer-designed shapes. Whilst companies such as Precision Circuits in Victoria and Reed Industrial Graphics in Queensland are doing some work in this area, in addition to Griffith University's involvement in exploring new electronics manufacturing technologies, it too is still and embryonic capability.

## COMPETENCIES

Beyond particular strengths relating to technologies, applications and vertical market solutions, the Australian electronics industry exhibits a number of important competencies. These include product and systems design, testing and certification, small-scale contract manufacturing and a unique capacity for a combination of process innovation and systems integration (i.e. problem-solving). With many smaller firms operating throughout the value chain, there is also a high level of collaborative competence.

### Product and systems design (conceptual and actual)

Electronics product and system design has changed significantly in recent years, as high-end development and design tools have become increasingly expensive. This often puts them out of the reach of smaller Australian companies. One response has been the emergence of a number of initiatives in Australia which seek to address the issue of shared infrastructure.

The Australian Microelectronics Network (AMN) is a national network of microelectronics engineers. Its members include major multinational R&D companies, leading manufacturers, electronics design consultancies, universities and individuals passionate about microelectronics. The AMN is now a forum of the Australian Electrical and Electronic Manufacturers' Association (AEEMA). Its mission is to establish microelectronics resource centres across Australia that can provide access to shared EDA tools and testing equipment.

The Victorian Microelectronics Designers' Network (VMDN) was established as a membership organisation focused on supporting microelectronics in **Victoria**. VMDN has identified photonics, biomedical

electronics and automotive as sectors for future growth. As a means of attracting more capable students into the industry and building design capability in Victoria, the Chipskills Program was developed through a collaboration of the Victorian Government, industry partners and four local universities. It offers a masters-level academic course that has been developed specifically to provide the skills needed in the microelectronics industry.

Indicative of competencies spanning design, collaboration and convergence, Victorian-based *MinFAB* offers customised manufacturing and advanced product development, exploiting leading-edge polymer microfabrication and integration of polymer microengineered systems. Services offered by *MinFAB* include: system design, integration and fabrication; sensors, microfluidic components and systems, bioreactors, biosensors; product design and process engineering; manufacturing solutions; systems for health, agriculture, food and aerospace industries; project management; and technology and business incubator support services. There are 15 companies operating from the *MinFAB* building at Caribbean Park, which

provides flexible space configurations and shared use of laboratories, kitchen and dining, conference and meeting rooms, gymnasium and common recreation area<sup>41</sup>.

*Spider Silicon* is a consortium of **South Australian** companies, academic and research institutions, specialising in integrated circuit design. Drawing on the strengths of its members, *Spider Silicon* is able to offer a wide range of design capabilities. As a significant special interest group, *Spider Silicon* works closely with the electronics industry in promoting silicon systems and silicon integrated circuit design solutions for new and developing markets.

Adelaide-based *Freescale Semiconductor Australia System on Chip* (SoC) Technology Centre (formerly Motorola Inc. Semiconductor Products Sector) incorporates a blend of focus areas comprising design of very large scale high-performance ICs, development of virtual models, front-end and back-end ASIC design services, and advanced CAD tool development. It is one of only a few global semiconductor centres of excellence which have been charged with the long-term mission to create the next generation of advanced semiconductor products for the networking, communications, and automotive markets.

**New South Wales**-based *Peregrine Semiconductor* developed the local industry's first 10Gbps fully integrated parallel optical quad transceiver. The transceiver uses Peregrine's UTSi Silicon on Sapphire CMOS IC technology and employs patented packaging and assembly technologies. These utilise the transparent sapphire substrate to flip-chip bond O-E devices onto the UTSi circuitry, forming the four transmitter and four receiver data channels. *Agere Systems'* IC design centre in Sydney

focuses on the design and development of ICs and systems for mobile phones and handheld devices.

Smartcard and point-of-sale technology companies, *ERG* and *Intellect*, in **Western Australia** also have significant product and system design capabilities. ERG has developed complex electronic payment systems for public transport networks, and has successfully installed systems in a number of major cities around the world.

### International level testing and certification of products and systems

The National Association of Testing Authorities (NATA) is Australia's Government-endorsed provider of accreditation for laboratories and testing facilities, and a peak authority in Australia for the accreditation of inspection bodies. NATA plays a key role in Australia's standards and conformance infrastructure; it acts as the national authority for accreditation of laboratories conducting tests, calibrations and measurements in a wide spectrum of technical fields, the national body for accreditation of producers of certified reference materials, and as a peak authority for the accreditation of inspection bodies. NATA represents Australia in the International Laboratory Accreditation Cooperation (ILAC), the Asia Pacific Laboratory Accreditation Cooperation (APLAC) and the OECD Working Group on Good Laboratory Practice<sup>42</sup>.

A number of organisations, including the Australian Electrical and Electronic Manufacturers' Association (AEEMA), Materials Australia, HRL Limited, the Institute of Instrumentation, Control and Automation Australia Inc (IICA), the Pressure Equipment Association Inc (PEAI), and the Victorian Centre for Advanced Materials Manufacturing (VCAMM), are proposing the establishment of a national compliance testing advisory service. This would assist local manufacturers in identifying and accessing the knowledge and services needed to achieve regulatory compliance, testing and approvals for their products—especially for entering international markets.

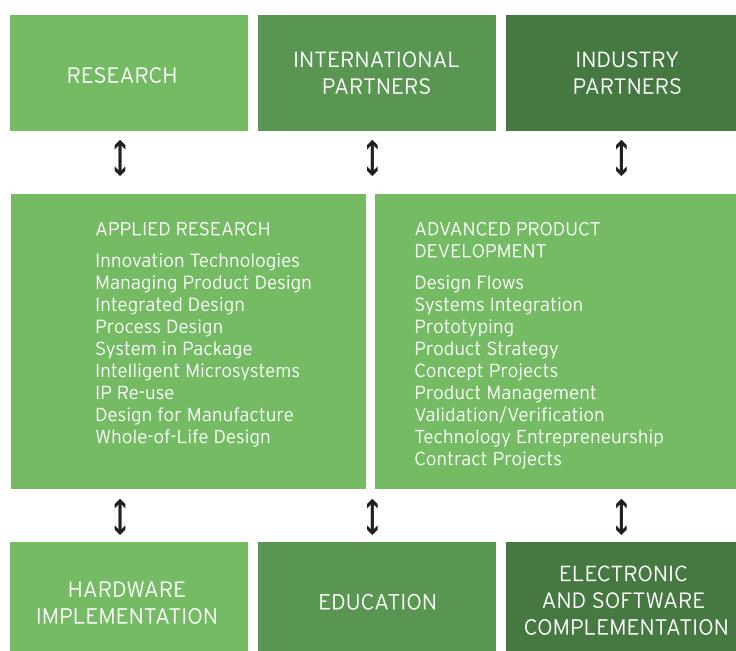
The National Networked Tele Testing Facility for Integrated Systems (NNTTF) at Edith Cowan University in Western Australia provides fabless companies and design houses with engineering, pre-production test and characterisation services. NNTTF has nodes at universities in every mainland state capital and is accessible through the web. It has leading-edge capabilities addressing the most complex testing and IP validation challenges, such as mixed-signal and high-end digital integrated circuit (IC) technologies, as well as other emerging technologies.

### Contract manufacturing

Internationally, the contract manufacturing sector has been experiencing increasing competitive pressures, and there has been some consolidation of activities. Nevertheless, the emerging trend for increased customisation and build-to-order promises to provide new opportunities for smaller scale and more flexible contract manufacturers and assemblers. Australian contract electronics manufacturers can competitively manage the production of low volume, complex products, particularly prototypes, with high quality design and engineering and fast turn-around. The ability to be flexible has proven as important for survival as scale.

Contract manufacturing and printed circuit board suppliers in **Victoria** include Precision Australia, AEMS (Startronics), Labtam, Duet, iPex, Millison, Clevertronics, and EDPM.

**New South Wales** has a range of contract manufacturing companies, such as GPC Electronics, Soletron Repair and Startronics (a new entity formed in late 2004 as a result of the merger of AEMS and HarTec), as well as Dayang and Steel River Manufacturing. Niche PCB supplier, Lintek, is also located in New South Wales. IMP Printed Circuits is located in **South Australia**, as are contract electronic manufacturers Parktronics, Entech and Tytronics. Global contract electronics manufacturer Sanmina-SCI is located in **Western Australia**, having purchased the ERG manufacturing facility. **Queensland** contract manufacturers such as Startronics and Surtek have considerable capacity and capability.

**FIGURE 8** PRODUCT REALISATION CENTRE

Source: Professor Trevor Cole, University of Sydney.

### Process innovation / Systems integration (Problem solving)

One of the most widespread capabilities in the Australian electronics industry is a combination of process innovation and systems integration (i.e. the ability to put existing things together in a new way, and to deliver an innovative solution to clients).

The South Australian electronics industry, with its emphasis on providing products and services for defence, has a particularly high level of capability in this area. The ASC, BAE, Saab and Tenix are all major players in providing integrated solutions. Similarly, Western Australia has a number of companies servicing the resources sector that have been called upon to support large-scale projects. In addition to this, there is growing demand from the shipbuilding industry

and for defence projects. Such projects also characterise activities in Queensland, the Australian Capital Territory and New South Wales (see Defence and Avionics, above).

The National Telematics Industry Initiative is an example of advanced systems integration combining a wide range of complex technologies (e.g. wireless/ICT, electronics, automotive, transport and smart building technologies) to create a practical operational solution. As the project has demonstrated, this capability combined with keen market analysis, offers significant industry development opportunities. Australian electronics companies have also been successful in developing integrated solutions to address other market opportunities, such as home entertainment and outdoor advertising.

A major conclusion of the Electronics Industry Action Agenda Industry Development working group has been that Australia's greatest weakness in innovation continues to be at the phase of converting an initial business concept into a proven business concept demonstrated by an industrially-relevant, pre-production prototype of the product or service. A mechanism to address this would be the establishment of a product realisation centre, which would use electronics and ICT as the key enabling technologies in which to embody the innovation (Figure 8)<sup>43</sup>.

### Collaboration

Another strength of the electronics industry in Australia is collaboration, particularly in production and in such areas as shared infrastructure. The Chipskills program, mentioned above, is an example, as is the Australian Microelectronics Network (AMN). In addition to these, there are many industry and state-based clusters and fora, networks and alliances focusing a wide range of electronic industry activities.

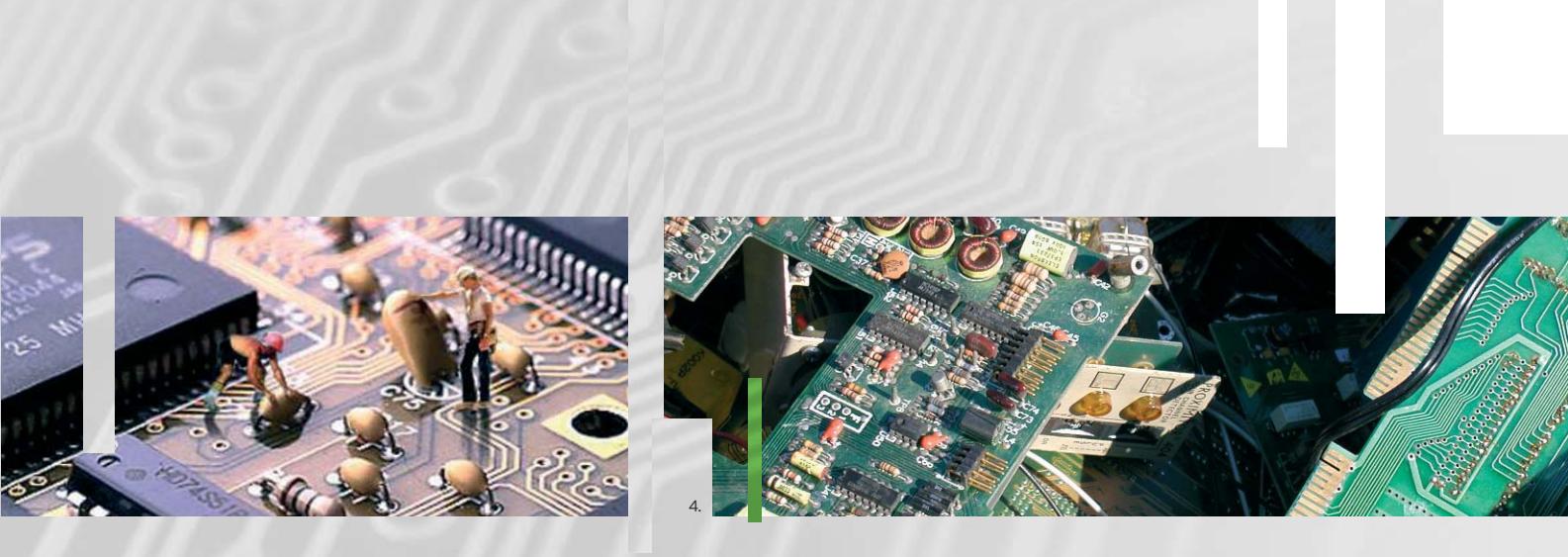
At the international level, an Australia/Taiwan Electronics and ICT Industry Strategic Framework Agreement, *Creating New Industries Together*, is being developed by the Australian Electrical and Electronic Manufacturers' Association (AEEMA) and Taiwan's Institute for Information Industry (III). The five key focus areas of the agreement are: technology research and product development, high value-added ICT manufacturing, strategic alliances, investment collaboration and trade facilitation. In addition to this, Australian firms, associations and groups participate in a wide range of international fora.

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Department of State Development and Innovation (Queensland)  
Department of Trade and Economic Development (South Australia)  
Electronics Industry Association of South Australia

## END NOTES

1. For example, it is estimated that 90 per cent of all future innovation in the automobile industry will be driven by electronics, with electronics representing up to 40 per cent of a vehicle's production cost by 2010. According to the Department of Defence, the value of electronics in defence related activities is even higher, with electronics representing up to 80 per cent of the production cost of a modern war ship or a submarine. Without a leading-edge electronics industry the ability of other Australian industries to build and sustain global competitiveness will be constrained.
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10. See, for example, [http://europa.eu.int/comm/environment/waste/weee\\_index.htm](http://europa.eu.int/comm/environment/waste/weee_index.htm)
11. See, for example, [http://europa.eu.int/comm/environment/waste/weee\\_index.htm](http://europa.eu.int/comm/environment/waste/weee_index.htm)
12. Electronics and related R&D socio-economic objectives include the core areas of computer hardware and electronic equipment, communication equipment and instrumentation, as well as the related areas of machinery and equipment and transport equipment.
13. ABS <http://www.abs.gov.au/>
14. <http://www.business.vic.gov.au/>
15. Houghton, J.W. (2005) *Australian ICT Trade Update 2005*, Australian Computer Society and Victoria University, Sydney and Melbourne.
16. NSW Govt. <http://www.business.nsw.gov.au/key.asp?cid=212>
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**HEAD OFFICE, CANBERRA**

**+61 2 6213 6711**

askus@investaustralia.gov.au

**SYDNEY +61 2 9397 1600**

askus@investaustralia.gov.au

**SAN FRANCISCO +1 415 243 2071**

sanfrancisco@investaustralia.gov.au

**NEW YORK +1 212 351 6570**

newyork@investaustralia.gov.au

**FRANKFURT +49 69 9055 8200**

frankfurt@investaustralia.gov.au

**LONDON +44 20 7632 0011**

london@investaustralia.gov.au

**PARIS +331 40 59 33 91**

paris@investaustralia.gov.au

**SHANGHAI +86 21 5292 8686**

shanghai@investaustralia.gov.au

**BEIJING +86 10 6532 2331**

beijing@investaustralia.gov.au

**SINGAPORE +65 6836 4109**

singapore@investaustralia.gov.au

**TOKYO +81 3 5232 3053**

tokyo@investaustralia.gov.au

[www.investaustralia.gov.au](http://www.investaustralia.gov.au)



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