



Australian Government

**Department of Communications,
Information Technology and the Arts**

**Centre for Innovative Industry Economic
Research Consortium**

**The Australian software industry and
vertical applications markets:
Globally competitive,
domestically undervalued**

Guide to the contents

Click on the bolded main heading to go to the hyperlinked table of contents in each section.

There are linked reference lists of figures, tables and boxes at the beginning of each section.

Introduction and executive summary	1
INTRODUCTION	4
The project team	
Background	
Reading this report	
EXECUTIVE SUMMARY	9
The software industry	
Vertical applications markets	
Export opportunities	
Globally successful, domestically undervalued	
 Part A: The Australian software industry	 20
THE SOFTWARE INDUSTRY AND MARKET MAPPING APPROACH	23
The mapping approach	
Limitations of the vertical market approach	
Mapping vertical markets and applications	
MAP OF THE SOFTWARE INDUSTRY	32
Evolution of the software industry in Australia	
Software producers	
Conclusions to software production analysis	
Distribution of software	
Conclusions on software distribution	
Software markets	
Conclusion to software markets	
Innovation base, infrastructure and framework conditions	
Conclusions on the innovation base	
ENDNOTES	94

Part B: Vertical markets 1 to 5	101
VERTICAL MARKET MAPPING	106
SELECTING THE VERTICALS	
Education	
Government	
Manufacturing	
Minerals	
Trade and commerce	
ENDNOTES	254
Part C: Vertical markets 6 to 8; export analysis	264
Energy	
Health	
Information and communications technology	
EXPORT MARKET OPPORTUNITIES	341
ENDNOTES	350
Appendices	354
PROJECT TEAM	
NATIONAL RESEARCH PRIORITIES	
DATA FOR SELECTED FIGURES PART B	
DATA FOR SELECTED FIGURES PART C	
List of acronyms	364

**Centre for Innovative Industry Economic
Research Consortium**

**The Australian software industry and
vertical applications markets:
Globally competitive and
domestically undervalued**

Introduction
Executive summary

Acknowledgements

The conduct of a research task such as this cannot take place effectively without the support and freely given time of many people. The project team wish to thank all of the individuals and firms who assisted us by providing helpful advice based upon their own experiences in software vertical markets, together with industry data and other input, and all the government and industry bodies who have assisted us to conduct this research and analysis.

They include, in particular:

- state/territory IT ministers and their staff in Victoria, Tasmania, South Australia, Queensland, Northern Territory, Western Australia, and New South Wales, and officers and staff from the respective departments in each of those states;
- staff and members of the AIIA, the ACS, Software Queensland, the Pearcey Foundation, IDC Australia, and Whitehorse Strategic Group;
- software developers and industry members, from every part of Australia; and
- DCITA staff, including Mr Greg Gurr and Dr Janet Pagan.

Disclaimer

While every effort has been made to ensure its accuracy, the Centre for Innovative Industry Research Inc and Whitehorse Strategic Group Limited do not make any representations or warranties (express or implied) as to the accuracy or completeness of the information contained in this report, and do not accept any liability in negligence for the information (or the use of such information) which is provided in this report.

Consulting team

Ian Dennis, John Houghton, Richard Hogg, Phil Singleton, Brett McLean, Robert Eames, Tina Xydias

Table of contents—introduction and executive summary

INTRODUCTION	4
The project team	4
Background	5
Reading this report	5
Mapping	6
Some definitions.....	6
Analysis of vertical markets	7
Limitations of the vertical market approach	7
EXECUTIVE SUMMARY	9
The software industry.....	9
Size and structure of the industry	9
Capabilities	10
Opportunities	10
Linkages.....	10
Issues/barriers.....	11
Vertical applications markets	12
Education	12
Government.....	13
Manufacturing.....	14
Minerals.....	14
Trade and commerce	15
Energy	16
Health.....	16
Information and communications technology	17
Export opportunities.....	18
Globally successful, domestically undervalued.....	18

INTRODUCTION

The project team

The project team was formed under the aegis of the Centre for Innovative Industry Economic Research Inc. (CIIER). This newly formed body brings together researchers and industry bodies to further our understanding of the innovative industries, including information and communications technology, biotechnology, nanotechnology and environmental technology.

The project team was supported by the Australian Computer Society (ACS), the Australian Information Industry Association (AIIA), and the Pearcey Foundation.

By necessity, some opinions have been expressed in this report. Those opinions are derived from the collective wisdom of the project team, informed by input from industry sources and from the many previous government and industry reports addressing issues relating to the software industry.

Comments made by software industry focus group participants also reflect their personal viewpoints and experience, and sometimes may not apply to the whole industry, or may reflect perceptions rather than reality. The opinions in this report are those of members of the project team, and do not necessarily represent the opinion of the Australian Government, or of the state and territory governments and industry bodies that contributed to this project.

It has been our intention in this report to present a balanced viewpoint. To the extent that we have failed in this we apologise. We have however, also borne in mind the necessity to draw some conclusions, rather than just to present the arguments. In so doing we have drawn upon the following quotation by Oxford University Professor Richard Dawkins, Charles Simonyi Professor of the Public Understanding of Science, for inspiration:

When two opposite points of view are expressed with equal intensity, the truth does not necessarily lie exactly halfway between, it is possible for one side simply to be wrong.

Background

This project had its genesis in the findings of the *Framework for the future* report prepared by McKinsey & Company in 2002. The McKinsey study concluded that the development of specialised software applications and the provision of specialist skills and services to multinational firms represented the greatest opportunities for Australian firms to participate in the global ICT industry. This study focuses on the first of these identified opportunities, software applications for vertical markets.

The key outcomes identified in the project brief were:

- the development of a map of the Australian software industry, including the concentrations of software firms and capabilities, significant strengths and weaknesses, and relationships between firms, key customers and the innovation base; and
- a strategic assessment of selected vertical software applications markets, and of the potential of these markets as a basis for sustainable growth for Australian software firms.

Vertical applications can be focused on a specific industry, and be closely associated with the work done in that industry (e.g. mining optimisation software), or be focused on activities that span industries (e.g. e-learning).

In the course of this study, focus groups of software developers and other industry participants were held in NSW, Victoria and Queensland, and were hosted by leading players in the Australian ICT industry, with the assistance of the ACS, the Pearcey Foundation, the AIIA, Software Queensland and State Government departments.

These were supplemented by case studies and/or industry meetings in Western Australia, South Australia, the Northern Territory and Tasmania, in order to ensure a sufficient level of Australia-wide coverage. Attendees at the focus group forums, and some other selected firms, were asked to respond to a standardised case study questionnaire in order to provide particular examples of software vertical market success, and to identify factors that have impacted upon their market success or failure.

In addition, each state and territory minister responsible for ICT was contacted to request cooperation from their respective departments. Meetings and/or discussions were held with representatives of Western Australia, Northern Territory, Queensland, South Australia, Tasmania and Victoria.

A number of vertical market experts were also consulted. These consultations supplemented our desk based research and provided a rich source of information.

Reading this report

We have presented the report in two sections. The first section (part A) addresses the industry mapping requirement, including all of those aspects of industry analysis relating to the whole industry. The second section (parts B and C) analyses the selected verticals and the particular opportunities which they present. In order to avoid

repetition, the chapters examining the selected verticals do not repeat aspects that are generic to the entire software industry that are dealt with in the first part of the report. Therefore, the vertical market chapters in parts B and C need to be read in the context of the entire report, not as stand-alone reports.

Mapping

In order to map an industry, it is necessary to understand its dimensions (e.g. employment, revenue, research expenditure and exports), its shape and structure (e.g. ownership, relative size, and components), and its significant features.

An industry does not exist in isolation. Its sustainability is affected by its environment which includes the commercial, legal and regulatory operating environment, the availability of capital and necessary skills and supporting infrastructure of public-sector research and development and the domestic market etc. An industry also displays characteristics that are derived from its history and influences.

For the industry mapping, and to explore the selected vertical applications markets, we have adopted a value or product system approach, thereby, situating Australian software developers in their industry, market and economic contexts. A product system encompasses production system relationships (both transactional and non-transactional) and includes suppliers, producers (firms/industry), distributors, clients and markets, the overarching regulatory framework and collective support infrastructure.

Some definitions

For the purposes of this study, *software firms are firms that develop software for the purpose of selling or marketing a product*, rather than applications that are developed solely for in-house use (emphasis added). Thus, software firms are firms that specialise in the development of software for sale as a product, or that provide software development services (i.e. over 50% of revenue from these activities). The software industry is the cohort of firms that are software firms.

Vertical applications markets include: (i) vertical markets for applications where markets relate to specific industry sectors (e.g. mining, government, health, etc.), and (ii) vertical applications markets relating to specific activities (e.g. e-learning, e-payments, etc.). As an illustration of this complexity, the table below maps some of the relationships between vertical markets and vertical applications that are studied within this report.

Software provided to a vertical market, such as the health sector, consists of both specifically designed health sector software, such as patient management systems, and horizontal software such as security and payment systems, that may or may not be adapted to the specific needs of health sector buyers. The health sector is also a market for vertical products, such as e-learning, that may, again be tailored to the market, but in which the suppliers are often more likely to see many markets as pertinent.

Accordingly, some software suppliers see their market in target-vertical market terms, but others define themselves by their product offerings.

Table 1. Indicative map of relationships between some applications and markets

Applications			Markets					
<i>Vertical</i>	<i>Market Specific</i>	<i>Horizontal</i>	<i>EDU</i>	<i>Mining</i>	<i>Energy</i>	<i>Health</i>	<i>Manu</i>	<i>T&C</i>
		ERP	X	X	X	X	X	X
		Security	X	X	X	X	X	X
		Payment	X	X	X	X	X	X
		Con/Mgt	X	X	X	X	X	X
		Web/Net	X	X	X	X	X	X
		Data/Mgt	X	X	X	X	X	X
	SCADA				X		X	
	CIS/Billing				X			
	CFAS				X			
	RTAC				X			
	CAD						X	
	Mine Mgt			X				
	Exploration			X				
	ECM/BPM						X	
	Financial							X
SCM			X	X	X	X	X	X
Logistics			X	X	X	X	X	X
Telemetry				X				X
e-learning			X	X	X	X	X	X
e-science			X	X	X	X	X	X
Clinical						X		
Clinic/Sup						X		
Patient						X		

Source: CIIER Analysis.

Analysis of vertical markets

We have selected a range of vertical markets that include both vertical applications markets and vertical market sectors, in order to explore the breadth of issues. Given the overall scope of the project, the analysis of the vertical markets is inevitably preliminary in nature. The focus is on identifying key features of the markets, vertical market opportunities and the potential of these markets to form the basis for sustainable growth for Australian software firms.

Limitations of the vertical market approach

There are number of limitations to a vertical market approach, in particular the treatment of specialist, non-specialist, in-house and non-market software production. It is implicit in the approach that software is produced by specialist software firms. As a result, there is an inevitable focus on the specialist software producers and a relative neglect of non-specialist producers (e.g. multi product and service firms), in-house production (e.g. extensive development of content and tools within the sector for own use and sharing), and non-market production (e.g. freeware and open source/open access).

There is also a focus on software development, rather than maintenance. A related limitation is that the focus on vertical software applications markets leads to a neglect of embedded software—be it embedded in hardware products, services or multimedia content. Given the extent of non-specialist, in-house and non-market software production in sectors like education, health and government, and embedded software production across a range of industries, this limitation is significant and must be borne in mind when interpreting the analysis.

EXECUTIVE SUMMARY

This report analyses the Australian software industry and includes a more in-depth analysis of eight selected vertical software applications markets (i.e. education, energy, government, health, ICT, manufacturing, minerals, and trade and commerce). It identifies particular industry strengths and characteristics, and explores export markets of significance and opportunity.

The software industry

The Australian Government's industry development objectives for the ICT industry are: to have a vibrant, competitive and internationally recognised ICT industry that can take advantage of international opportunities and make a greater contribution to economic growth; and to have globally competitive industries that make effective use of ICT.

The software industry is an important and integral component of the Australian ICT industry. It is significant in its own right, as a substantial exporter of products and services, and it is strategically important to the competitiveness and sustainability of all Australian industries, the development of new goods and services with enhanced functionality, and the cost effective delivery of health, education and government services. It is also a highly diverse industry, both in terms of the markets in which it operates and in terms of its geographical location. There is no single centre for the software industry, there are many, and they are all over Australia, in every state and territory.

The Australian software industry is at an exciting stage of its development. It includes both well-established and mature globally competitive companies, and new and emerging start-ups. It is strongly export focused, and has a deserved reputation for quality. While it is an integral part of the global ICT industry, it has the capacity to stand on its own feet and compete internationally.

Size and structure of the industry

CIIER estimates that in 2004–05, the Australian software product industry employed around 17 000 staff, supported by nearly 7000 development staff, and earned AUD 2.7 billion, of which \$830 million went to Australian developers. International markets accounted for \$290 million of this revenue, with \$226 million going back to the software developers. The industry spends \$66 million a year on R&D.

The computer software and services industry includes a large number of small firms. In June 2003, no less than 97% had fewer than 20 employees and 99.6% had fewer than 100. Nevertheless, a relatively small number of larger firms dominate most markets, of which the majority are foreign based multinationals though there are a few relatively large indigenous software firms.

Capabilities

Australia's main strengths in the development of software products are long-term experience in the field, compared to many other countries, and the quality of software personnel. Specific software industry strengths identified during the focus groups, included: relatively low costs for software development (compared to US and Europe), strong Unix and open source skills, multicultural workforce and language skills, well educated and open society, well established and representative industry bodies, competitive and discerning domestic market, technological leadership in a number of vertical markets, technological leadership in some software niches, and higher quality finished software products than world norms.

There was a strong feeling among those consulted that the relative strength of Australian software producers was under-appreciated and under-valued by other industries and by many in government.

Opportunities

Software export opportunities abound, but there is marked variation between regional, national and vertical applications markets. For a number of vertical markets, the US may not offer the most responsive target, despite its size. The 'common heritage' of the Commonwealth has resulted in a higher degree of commonality in practices and legislation in those countries within or formerly part of that grouping, and they offer many export opportunities.

The most significant emerging markets are in South East Asia, Central Asia and Eastern Europe, but the significance of each of these and the merits of particular countries within the regions, varies depending on the vertical software market, and can vary considerably for particular segments within a specified vertical. As a general rule, those countries with greater cultural compatibility to Australia offer the easiest potential market entry (e.g. New Zealand, UK, Singapore, India, Canada, Malaysia).

The ICT industry might consider a sectorally targeted software export strategy, based upon specific vertical software market missions to selected regional and country targets. There may also be scope for more structured links between firms within the vertical markets being explored, as the limited feedback derived from the various focus groups and case studies has indicated a commonality of interest and the potential for useful cooperation between Australian software developers who are interested in growing their businesses in the same vertical market.

Linkages

In many markets, software developers benefit from close linkages with leading clients, which often drive innovation. Strong user-producer linkages, deep vertical market understanding and clients who are leaders in their industries are the hallmarks of success (e.g. mining software). Conversely, markets with a high degree of mediation, with software sold through the wholesale-retail channel, through multinational channel partners or through embedding in electronic equipment, present many challenges for would-be software developers.

There are also benefits for developers in maintaining strong linkages with a range of players involved in the industry's regulatory and support infrastructure. These include: technical and quality standards bodies, intellectual property and business regulation, professional and product accreditation agencies, business support services, industry networks and clusters, and advisory and support agencies. Of particular importance for Australian software developers are close linkages with skills suppliers, education and training agencies, and finance and venture capital providers.

A number of overseas owned ICT companies have extensive operations in Australia, and, in some cases, a history of significant investment and research in Australia. Attracting ICT MNCs to locate in Australia can increase employment, and often creates flow on investment. Some overseas owned ICT MNCs have active and supportive linkages with local companies through clusters and networks, some work closely with Australian industry and some with Australian research bodies.

Many of these activities are of direct benefit to the Australian software companies with which the overseas owned MNCs relate. Such strategic engagement, however, is always predicated upon strategic benefit for the MNCs concerned, in particular, enhanced market access and/or increased market share. While MNCs can offer significant support to the Australian software firms and the industry more generally, each arrangement needs to be carefully evaluated by the companies concerned.

A notable feature of the ICT industries is that the vast majority of ICT-related R&D is conducted in the business sector. As a result, public sector research plays a relatively small role in ICT-related innovation. Nevertheless, there are opportunities for software developers to forge stronger linkages with ICT focused R&D (e.g. NICTA) and with ICT-related R&D being undertaken in vertical market oriented R&D centres (e.g. in mining, manufacturing, health, etc.).

Such linkages would provide both access to R&D skills, strategic knowledge of technology advances and opportunities relevant to the user industries and the potential to commercialise non-specialist and in-house developed software.

Issues/barriers

The industry's major weaknesses include the difficulty of gaining appropriate investment capital, maintaining domestic market share and developing supportive relationships with the public research base. These weaknesses need to be addressed by the industry, but they cannot all be addressed by the industry alone. There are many points at which policies affect demand and market share, with privatisation of energy utilities, communications and transport, government outsourcing, health, education and defence contracting among the more important.

The local industry needs local demand from lead customers investing collaboratively in lead projects. Privatisation and procurement policies can substantially add to the opportunities for Australian firms if they take into account the potential for development and commercialisation in lead projects by identifying development products at the design and contract point. For example, where a State Government is intending to commission a Land titles or Land planning system, it would be worthwhile

to consider whether other state governments, or, indeed, other countries or provincial governments, have a need for such systems, and to design in to the systems the features required by potential additional users.

The further development of mechanisms for shared exploitation of intellectual property also includes the potential for shared usage by other agencies, as well as the potential for commercial exploitation by the developers. Such an approach, and the consideration of product oriented design briefs as part of this process are already allowed for under Australian Government and some state government purchasing frameworks. However, their adoption would require changes to some current public and private ICT procurement practices, yet could act as a major stimulus to software product development.

With appropriate policies and programs of support, the Australian software industry can continue to make, and can improve, its significant contribution to Australia's ICT exports and to Australia's overall economic growth.

Some recent analysis has identified significant software production outside the dedicated software industry. While some non-specialist software development may be translated into marketable software product, a significant amount will not. There are inherent differences between the requirements for internal use of software and the production of marketable, supportable, cost-effective, software product.

Vertical applications markets

We have selected a range of vertical markets that include both vertical applications markets (e.g. e-learning) and vertical market sectors (e.g. energy and minerals), in order to explore the full breadth of issues.

The minerals and health software markets seem to offer the most promising opportunities and they have Australian suppliers well established internationally. Segments of the energy, government, ICT, manufacturing and education market verticals also show considerable potential.

Education

Education is characteristically a services market, offering relatively few opportunities to sell stand alone software products. Moreover, there is a strong tendency for non-specialist and in-house development in the education and research market, and adoption of open source/open access, freeware, shareware and 'sharedware' (i.e. software that is created by and freely distributed among teachers and researchers).

Hence, the market addressable by specialist commercial software developers is smaller than overall e-learning and e-research activity would suggest. Such factors as accreditation and approval, the presence of key accreditation gatekeepers, the importance of standardisation and the emergence of purchasing consortia, also tend to influence and constrain market opportunities.

In the key areas of tools and systems, there are already major players in the e-learning software marketplace and in many areas of content development and access. Where

these are being challenged (e.g. by the emergence of open access publishing), the tendency to adopt open access and/or open source systems limits commercial market entry opportunities, unless firms develop sustainable open source/open access business models. There are opportunities in areas such as improved functionality and integration of the various system elements, but increasingly such opportunities require some scale to be commercially exploitable.

Demands for interoperability and preference for open source solutions in the e-research segment are also likely to limit opportunities for Australian software firms, although there may be significant activity in the development of middleware and tools to support the rollout of e-science and grid computing systems.

For all these reasons, the opportunity for Australia to grow firms domestically to become internationally competitive suppliers of software products into the e-learning and e-research vertical application markets may be more limited than market hyperbole during the 'dot com' boom years would have suggested.

Government

There are several promising areas of growth for Australian software developers in the government vertical market. The three standouts CIER identified are content management, security and geospatial technology where the number of Australia players and the strength of the innovation base indicates a level of domestic capability and local expertise which improves the overall probability of success.

There are significant opportunities in developing countries which are enthusiastically embracing e-government. The European countries are being forced to consolidate their e-government sites and they too offer good opportunities for content management providers. If they have not done so already, Australian security software firms might make a concerted attempt to become involved with the US government's security and authentications programs.

The experience could stand them in good stead in other markets. Australian governments might take the opportunity to evaluate local providers of content management tools when undertaking procurement for their e-government websites.

Geospatial and cadastral e-government applications will become more important in the years ahead, although the expense of such systems will, for the time being at least, make them of interest to only the most sophisticated governments.

The basic infrastructure and transaction tools segments do not include significant numbers of Australian developers. We suspect that this is because these areas are the most mature and are already well catered for by larger software firms. Despite the fact that they are growing, seeking a foothold in these segments will be difficult given the level of competition.

Although there is a strong Australian presence, the payment gateway segment is also a crowded market in which vendors should concentrate on value adding and differentiating.

It is likely that customer relationship management (CRM) technology designed for use by government will be an area of increasing activity in the coming years. Australia does not have a strong presence in this market, and those firms that do participate are not focused on the government sector. These firms may want to consider the e-government vertical market in the future.

Manufacturing

In the manufacturing vertical market, there is an opportunity for Australian software developers to sell specialist modules using the global enterprise resource planning (ERP) vendors as channel partners. In many parts of the world the integration aspects of manufacturing needs also represent opportunities, with the potential to extend the current base-level ERP applications by connecting specialist modules developed for niche markets in Australia.

Developers could also focus on application service providers (ASPs) and Web Services in support of major ERP platform solutions. However, such modular gap-filling will only work if Australian developers are credible with both clients and ERP vendors.

Small developers may need help to develop their channel partner strategies. To prepare themselves for genuine partnering, Australian developers need to focus on manufacturing niches by understanding their particular needs and providing products that do not require extensive configuration or rewriting.

CIIER considers that strategic cooperation with the ERP majors is one of the best opportunities to on-sell locally developed solutions and it is sustainable provided the Australian operation remains sufficiently independent to avoid being acquired or absorbed by the ERP major.

Australian vendors are not locked out of any geographic area, but one size will not fit all markets. Niche specialisation will be the strategy most likely to succeed in mature markets. On the other hand, developing markets offer opportunities to sell non-finance modules and SME specific products.

Few countries are better positioned than Australia to offer integration services to Asia with a combination of country presence and support from base without the difficulties of long distances or significant time zone shifts.

Minerals

Minerals software is one of Australia's success stories. Australia has a strong domestic and international market position, particularly in mine management, exploration, mine planning and geological survey and mapping. Firms range from major international players to new emerging start-ups, and many niche firms with very clear ideas about their preferred product range and target markets. Strong linkages between developers and leading edge clients are important to this success story.

Emerging markets in China, India, Eastern Europe and the Middle East potentially will have significant depth and they are, in many cases, already being served by leading Australian software producers. The export culture and focus of this part of Australia's software industry is very strong.

Industry consolidation is taking place, and it is likely to accelerate. However, this is unlikely to result in a less competitive marketplace, as the circumstances within Australia are likely to generate new players to champion new technologies or develop new ideas.

A further interesting trend can be seen in moves towards an expansion of target markets outside the minerals industry. Companies, such as Mincom, are now focussing increasing effort on other sectors, such as energy, transport and logistics, and are swiftly becoming significant suppliers into these vertical markets as well as to their traditional market.

Trade and commerce

There is more realism in the trade and commerce vertical market, as firms have discovered that implementation difficulties and internal business process problems have meant that expensive investments in e-commerce platforms and supply chain technology have not delivered the anticipated results. The markets are experiencing growth, but it is not spectacular.

Australian firms looking for large market growth in the e-commerce platform area, payments gateways, and supply chain and logistics will be competing against foreign firms that often have greater experience including with the most demanding clients and markets.

The evidence does not indicate that the e-marketplace, e-procurement and transactional hubs market segments are set for continued dramatic growth. Australian firms involved in these segments should evaluate their options carefully, and continue to monitor developments overseas to see how other firms are realigning their business strategies in response to slow growth. Payment gateway providers are likely to face growing pressure from the large US based operators, which will put pressure on local operators and make independent sales of software difficult.

Australian players in this market segment might consider exploring different payment options, as Bill Express has done with its pre-pay mobile technology. The increasing problem of online fraud will cause changes to the conventional credit card based approach, and to succeed in this area firms will require good relationships with banks and credit card firms, as it will be these organisations that drive standards and set the pace and direction of change.

Because of the complexities involved, the supply chain segment in Australia is not progressing rapidly. Apart from the larger firms that have the resources and commitment to undertake supply chain improvement properly, successes have been moderate. It seems that implementing a successful enterprise wide supply chain project requires doing the 'hard yards', and may simply be beyond many firms. Australian firms working in this segment should select their target markets carefully. Nevertheless, there are some interesting niche developments in the supply chain segment based around web hosted service offerings.

Recent changes in world customs regulations mean that there are opportunities and willing customers for state-of-the-art compliance software. The competition in this area

appears fragmented, and a well developed platform that can be easily integrated within a business's existing processes and with their existing internal systems may enjoy good opportunities in many countries. Most Australian firms are small, however, and the difficulty lies in achieving the growth and scale necessary to compete offshore when starting from a small base.

Energy

Investment in both the utilities sector and the energy demand management sector is likely to increase in the coming years, providing opportunities in this vertical market for software firms.

Our analysis indicates that there are several Australian firms positioned to take advantage of some of the opportunities in the Real Time Automation and Control (RTAC) segment (e.g. SCADA and Interval Metering) as well as Trading and Risk Systems, and Enterprise Asset Management Systems.

Australian software firms looking to increase their presence in these areas may need to establish strong relationships with the manufacturers of electrical and gas hardware (e.g. transformers, switches, meters, etc.) to participate successfully in the market.

In the GFAS (geospatial and field automation solutions) segment, Australia has a number of spatial information firms that could participate, but presently do not. The potential also exists for these firms to team up with firms supplying asset management systems, thus adding a geospatial element to these packages and, potentially, take a lead in both areas.

The increasing focus on sustainable energy should stimulate innovation in the energy efficiency segment. The market for architectural products for designing energy efficient buildings and determining energy ratings will continue to grow, but we expect strong competition to come from established CAD package developers.

In the area of operational efficiency, there are opportunities in what is an emerging market. Firms that can productise specialist knowledge resident in the consulting firms and universities may become the most successful players in these areas.

Health

A key opportunity for Australian health software firms lies in taking advantage of rapid change and growing sophistication in e-health in Australia. The fundamental drivers of change will be the level of adoption by the Australian health sector of emerging interoperability standards being promoted by government (e.g. HL7) and the level of commitment to engaging in health informatics standards bodies around the world.

The greater the involvement by Australia in these bodies, the greater will be the profile and level of respect in which Australian health software will be held in foreign markets, and the greater will be the opportunities created by networking.

Recent moves in the US to reduce health care costs through federally coordinated programs, suggests that the health IT models being promoted in Australia will have applicability in that market too, provided that standards are compatible.

The Canadian and New Zealand markets are experiencing similar changes to those in the Australian market. Australian firms that can demonstrate a successful software product in their local market may also find opportunities in these two markets because of their similarity. Some aspects of India's health sector also appear attractive, including the relatively well financed private hospital chains and the private health insurance market.

The UK is a highly desirable market, but with significant competition. Successful entry into this market requires substantial financial resources and, perhaps, relationships with some of the prime contractors on the key projects.

From the perspective of the various market segments, the Australian software industry appears best placed to make its greatest gains in the areas of clinical support systems and clinical systems, and there are also potential opportunities in patient administration and infrastructure.

Those concentrating on the general practice market in Australia appear to have established barriers to entry for foreign competitors by obtaining large market share, thereby becoming the de facto standard. The situation in sophisticated hospital systems is quite different, with foreign MNCs proving to be tough competition, even in the domestic market.

It is likely that the level of sophistication of Australian software producers will increase, driven by the intense focus by the Australian government on improving the interoperability of IT across the health sector.

Those companies able to meet the demanding requirements of the current suite of e-health projects, as well as securing contracts ahead of tough foreign competition, will be in a good position to compete in sophisticated overseas markets.

Information and communications technology

The ICT market sector offers good opportunities to those who have developed software products able to fill a niche market—particularly for tools. Unlike the application software market, where large multinationals play a dominant role, the software tools market is more accessible to smaller firms—as the large multinationals tend to focus on the high cost, high profile projects for large corporates.

There are a number of leading-edge software products that have the capability to position their Australian developer at the top end of the global market niche and some firms have already achieved this status.

The experience of successful exporting firms shows how difficult it can be to break into, and gain a foothold in, overseas markets where significant competition already exists. For that reason, developing countries with relatively open markets may provide opportunities and the best opportunities may lie in the Asia-Pacific.

This applies to most vertical market software products, except software development languages, where the market presence of MNCs is strongest. Australian-developed products other than languages (e.g. web tools, data integration and data management) would seem to have the capacity to compete alongside products from other countries.

Export opportunities

Export potential was assessed for each of the vertical software market sub-sectors that we analysed, and a ranking was allocated to each of the major international regions for comparison purposes. Regions were categorised for Australian software of each market segment as being a well established market, a strong potential market, or a less advantageous market. One result of this analysis is to show that the significance of regions for export potential varies considerably for particular vertical markets, suggesting a need for significantly different and tailored export programs.

The most significant emerging markets in high-growth regions of the world, include those in South East Asia, Central Asia and Eastern Europe, but the significance of each of these, and the merits of particular countries within the region varies depending on the vertical market, and can vary considerably for particular market segments within a specified vertical.

As a general rule, those countries with greater cultural compatibility to Australia offer the easiest potential market entry (e.g. New Zealand, UK, Singapore, India, Canada, Malaysia).

We would recommend consideration by the ICT industry of a targeted software export strategy, based upon specific vertical market missions to selected regional and country targets.

Globally successful, domestically undervalued

The Australian software industry is globally successful, but we consider that it is domestically undervalued. Its global success has come predominantly through individual entrepreneurial effort, often at great personal sacrifice, rather than from a coordinated industry focused process.

Few software companies are household names and many of the most successful companies are almost anonymous outside the vertical markets in which they operate, but this is, in fact, a mature and well-established industry..

If software can be so successfully exported with little targeted assistance, how much more could be achieved with a little more backing. As noted, some of that backing could come through more consistent purchasing of Australian products in Australia, particularly through increased opportunities to participate in lead projects. Anecdotally, it is reported that other Australian SMEs and local government buy Australian products, but larger entities, public and private, are more reluctant to do so.

One focus group comment on the banking and finance sector illustrates this: ‘They almost inevitably ignore Australian products and buy imported products that then need extensive modification.’ A further, more disturbing comment about a state government was: ‘We sell ‘x’ infrastructure software to governments all around the world, but our own state government bought an imported product that we regularly beat in open competition’.

However, more than just improved domestic market access is required, and the industry must accept responsibility to improve its own performance. While it is not the function of this report to develop or propose how this might be done, some broad suggestions have been derived from the extensive analysis, consultations and focus group discussions.

Centre for Innovative Industry Economic Research Consortium

**The Australian software industry and
vertical applications markets:
Globally competitive and
domestically undervalued**

Part A

The Australian software industry

Table of contents

THE SOFTWARE INDUSTRY AND MARKET MAPPING APPROACH	23
The mapping approach.....	23
Mapping the software product system (the analytical framework).....	23
Mapping vertical markets and applications (the presentational framework).....	27
Limitations of the vertical market approach	28
Mapping vertical markets and applications.....	29
Structure of the value or product system	29
Nature of the value or product system.....	30
Stage of innovation and development.....	30
Innovation linkages	31
MAP OF THE SOFTWARE INDUSTRY	32
Evolution of the software industry in Australia	32
Software producers.....	35
Statistical overview of the software industry	35
Software and services survey base	36
The Australian software and services industry—key statistics	37
Software exports	39
Software and services employment, revenue and research expenditure	40
Summary of software industry statistics.....	51
Software production analysis	54
Australia's software industry strengths	56
Australia's software industry weaknesses	57
Conclusions to software production analysis.....	58
Distribution of software	59
Software distribution models.....	59
Market entry techniques.....	62
Conclusions on software distribution	66
Software markets.....	67
Market dynamics	67
Conclusion to software markets.....	75
Innovation base, infrastructure & framework conditions	76
Domestic framework and infrastructure	76
The ICT research base	79
The skills base	88
Conclusions on the innovation base	90
Endnotes.....	94

Figures

Figure 1.	A schematic product system	25
Figure 2.	The software product system	26
Figure 3.	Vertical applications map (education & research example).....	28
Figure 4.	CSIRAC: Australia's first computer	32
Figure 5.	Australian ICT industry structure (employment shares).....	33
Figure 6.	Software imports and exports, 1994 to 2004 (AUDm)	40
Figure 7.	Trends in software and services employment, revenue and R&D, 1999 to 2004	41
Figure 8.	Indicative revenues of software and services firms by major product/service, 2004.....	42
Figure 9.	Revenue from software products, 2004 (AUDm)	43
Figure 10.	Software and services employment by head Office location.....	45
Figure 11.	Software and services revenue by product / service, and Head Office location	46
Figure 12.	R&D expenditure by software and services firms in Australia	47
Figure 13.	R&D by primary software activity of software and services firms	48
Figure 14.	Primary markets of software and services firms in T250.....	49
Figure 15.	All markets selected by software and services firms in T250, 2004.....	50
Figure 16.	Market by head office location of software and services firms in T250, 2004	51
Figure 17.	Three dimensions of software markets	68
Figure 18.	ICT MNCs in alliances with Australian SMEs, December 2004.....	71
Figure 19.	Market selection indices for selected countries	74
Figure 20.	BIE software export market evaluation, 1989.....	75
Figure 21.	Share of R&D expenditure on information & communication services (SEO)	80
Figure 22.	Share of R&D expenditure on ICT sciences (FOR), 2000-01	81
Figure 23.	University ICT intake and graduations (Australian residents), 2001-07	89
Figure 24.	University ICT intake and graduations (total), 2001-07	89

Tables

Table 1	Statistical model.....	36
Table 2	ICT world market 2004-08.....	38
Table 3	Software employment, revenues & R&D expenditures (AUDm).....	52
Table 4	Physical distribution models: pros and cons	60
Table 5	Financial distribution models: pros and cons.....	61
Table 6.	Market entry techniques.....	63
Table 7	Sample of countries with smaller domestic ICT markets	69
Table 8.	ICT related R&D expenditure by field of research, 2002-03.....	82
Table 9.	ICT related CRCs.....	83
Table 10.	Whitehorse ICT R&D database, June 2002	84
Table 11.	Focus of ICT research in the public sector by number of research centres, 2002.....	85
Table 12.	Australian software trade, 1994 to 2004 (AUDm).....	91

Boxes

Box 1.	How many firms can be 'grown' from Australia?.....	43
Box 2.	The nature of success factors	64
Box 3.	Canon Information Systems Research Australia.....	72
Box 4.	Qualitative commentary	86

The software industry and market mapping approach

This section presents an outline of the industry and market mapping underpinning this study and lays the foundation for the analysis that follows.

The mapping approach

To map the software industry activities, we developed a framework for analysing the software industry and software value chain and a schema for presenting the actors and activities involved in the software industry, with particular focus on selected vertical applications markets. These *analytical* and *presentational* frameworks are described in turn.

Mapping the software product system (the analytical framework)

There are many possible approaches to mapping software industry activities and markets, ranging from various forms of cluster analysis to value chain/value system, product and innovation systems analysis. Each provides a particular perspective that is more or less suitable to a particular type of study or enquiry.

Within these approaches there are many overlapping and cross-cutting dimensions. One basic distinction is that between those studies using clusters in a statistical sense (i.e. a grouping of entities according to some specific characteristic) and those intending to imply actual relationships between the objects (i.e. networks, value or product systems).

When clustering is studied it can be in terms of any number of characteristics (e.g. location, activity or product field, firm strategy, behaviour, innovative or competitive performance, size, technology or science base) and involve a range of methodological approaches (e.g. factor analysis, cluster analysis, multi-dimensional scaling, etc.).

Network, value chain or product system relationships are typically studied in terms of linkages of various kinds (e.g. supply chain, user–producer relations, supplier–producer relations, innovation linkages, information and/or knowledge flows) and typically involves more qualitative methods (e.g. case studies or representative sampling).¹

Cross-cutting, or overlaying this basic distinction is that between studies having a geographic dimension and those without. Spielkamp and Vopel (1999) described this distinction as that between ‘milieux or districts’ and ‘clusters, chains or networks’ respectively.² Given the focus of this study on software industry activities and vertical applications markets we chose to adopt an approach which focuses on vertical production or value chains, networks or systems in which user–producer relationships (be they mediated or direct) are central.

One such approach, the product system approach, was pioneered by the United Kingdom’s Complex Product Systems Innovation Centre.³ It is a technique that focuses on linkages between actors in a complex system that affects the transformation of activities and materials into goods and services through the processes of creation, production and distribution.

Its genesis was in analyses of the building and construction industry, in which learning and innovation are difficult because of the one-off nature of construction projects, with different constructions being produced in different locations, with different teams of architects, engineers, building and construction firms, project managers and trades people in each case.

One reason for wider adoption of the complex product system framework is that building and construction is an example of what is becoming an increasingly common phenomenon—namely, the complexity of putting together a wide range of products and/or services, and integrating them into a solution for a particular client and/or project.

Hobday, Rush and Tidd suggested that because each new product tends to be different, and because development and production involves feedback loops from later to early stages and other unpredictable, ‘emerging’ properties, innovative organisational structures are required to coordinate production, particularly where there are uncertain and changing user requirements and technological possibilities.

There is often high production and innovation complexity, not only because a wide variety of distinct components, skills and knowledge inputs are involved, but also because large numbers of firms or different organisations often have to work together in production (e.g. prime contractors and systems integrators, users, buyers, other suppliers, small and medium sized enterprises, government agencies and regulators).⁴ Such a characterisation fits the software industry, especially when the focus is on vertical market applications.

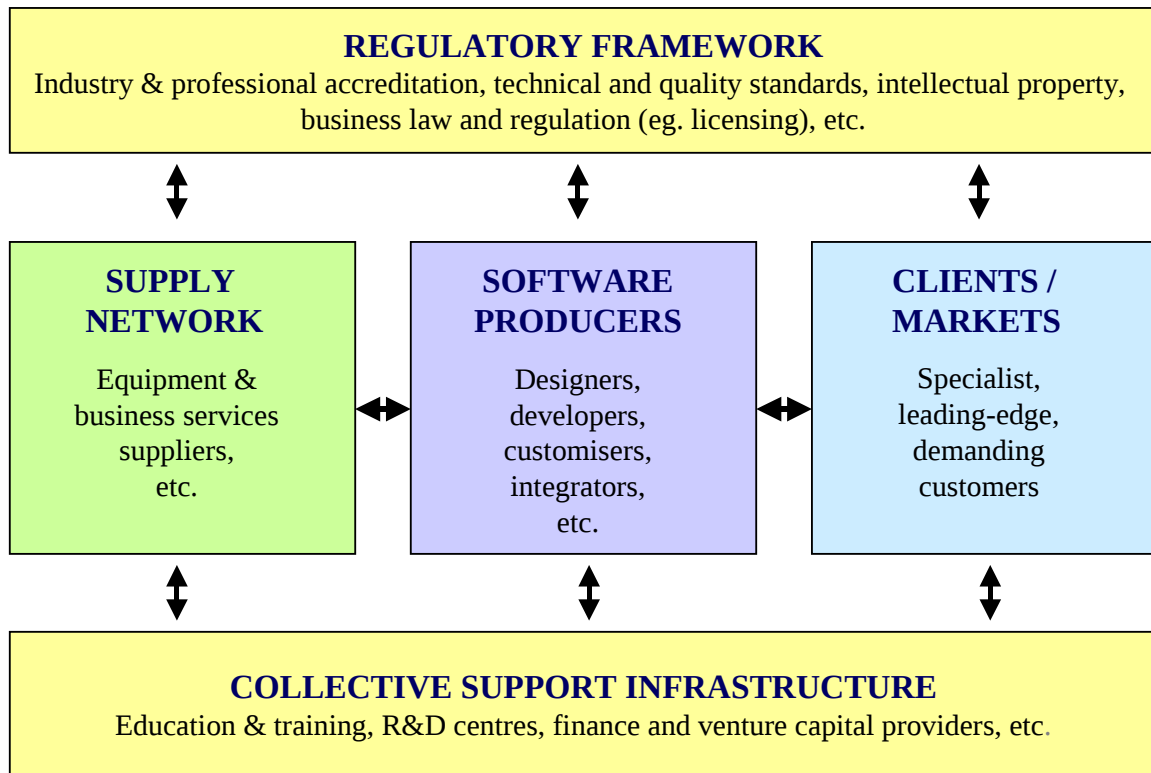
A typical schematic product system includes five major elements, with three groups of key actors and activities forming the core value chain. Figure 1 illustrates a basic schematic product system:

- at the centre are the *software firms* engaged in the development of software and software based solutions;
- to their left, the *supply network*, which includes all the providers of specialist equipment and financial, business and other services to software producers; and
- to their right, the *distribution network*, which includes all the clients of software firms (be they intermediaries or final customers).

Their activities of these groups are supported by a collective support infrastructure and operate within an overarching regulatory framework.

- The *collective support infrastructure* includes R&D centres, education and training institutions, professional associations, specialist consulting firms, finance and venture capital providers, etc.
- The *regulatory framework* includes a wide range of industry and professional accreditation, technical and quality standards, intellectual property, licensing, etc.

Figure 1. A schematic product system



Source: CSES Analysis.

This basic schema was modified to draw out particular insights in the vertical market applications, taking into account the following.

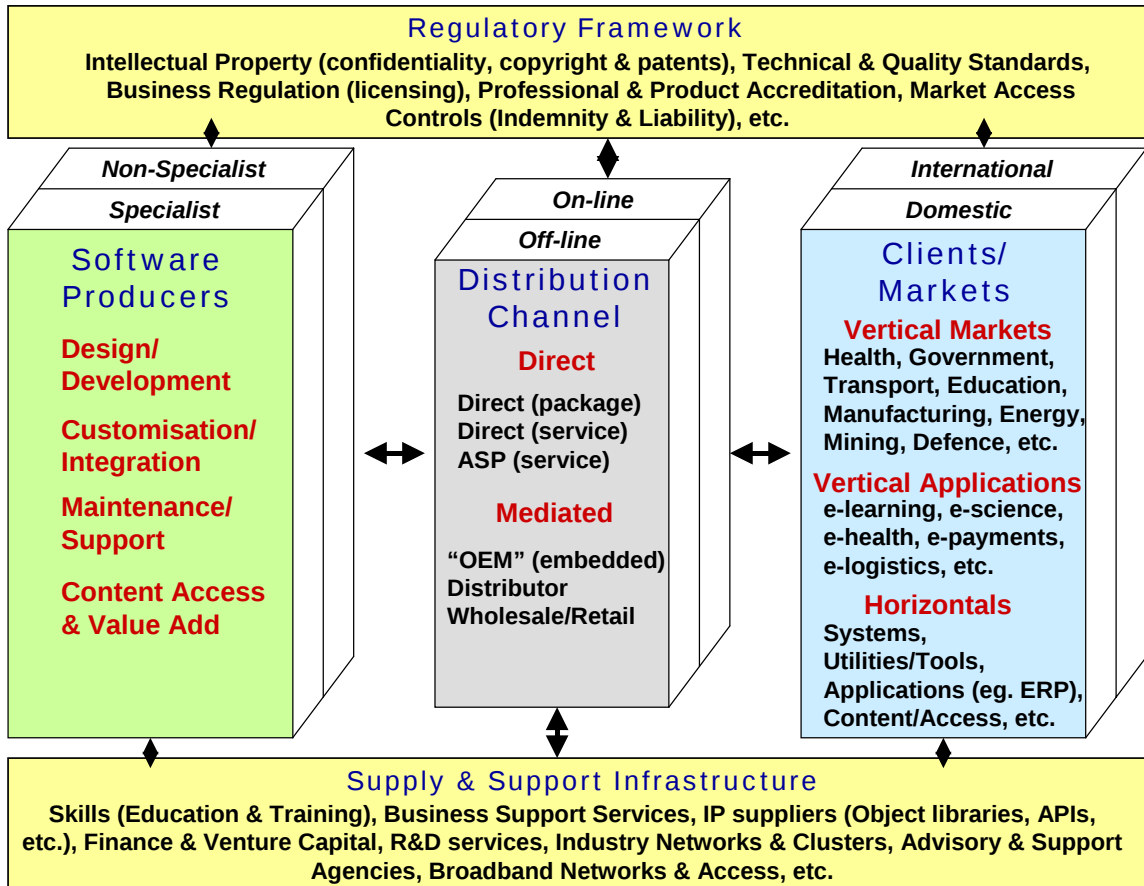
- In the context of production, there is a continuum through which technologies or techniques are translated into applications, and are then built into solutions for a particular client group or market. For example, encryption is a technology that can be applied to security and become a part of a range of vertical market solutions (e.g. protecting health records in e-health, document security in defence and government, etc.).
- Software-related capabilities can cut across applications and markets. For example, digital image manipulation capabilities can be an essential ingredient in the development of computer games, medical scanning and imaging, film and video special effects, production and editing, etc.

In mapping ‘software firms and capabilities’ we took account of these dimensions, mapping capabilities in terms of the technologies, applications of those technologies and the clients and vertical markets in which they may, or do emerge as solutions.

We also identified the role of key actors in the value chain—as, for example, developers, distributors, integrators and/or value-added services providers. Given the importance of the distribution channel and distribution business models in the software industry, as well as the limited requirements of software firms for specialist inputs, we modified the traditional schematic product system structure outlined above—with the supply network included within the support infrastructure, and the distribution channel separated from clients/markets. This

formulation reflects both the importance of the distribution channel in the software industry, and the focus of this study on particular clients and vertical applications markets.

Figure 2. The software product system



Source: CSES Analysis.

Taking these considerations into account, we developed a software product system map (figure 2) which includes the following.

- *Software producers*, including specialist firms and major non-specialist developers and producers, defined by their main activities—i.e. design, development, customisation, integration, support, etc.
- *The distribution channel*, defined by major channels of direct and mediated software distribution—i.e. direct (package or service) and mediated (embedded, wholesale/retail), be they on-line or off-line, etc.
- *Their clients and markets*, defined by industry/market or application and software industry linkages—i.e. market verticals (e.g. health, government, transport, education, etc.), application verticals (e.g. e-learning, e-logistics, e-payments, etc.) and horizontals (e.g. systems, utilities, tools, ERP applications, etc.), be they domestic or export

- The collective *supply and support infrastructure*, defined by activity and contribution—i.e. education and training, business support services, R&D centres, finance and venture capital providers, industry networks and clusters, etc.
- The overarching *regulatory framework*, defined by scope and area of activity—e.g. intellectual property, business law (e.g. licensing), technical and quality standards, product and professional accreditation, etc.

This map provides a framework for thinking and analysis, which focuses on software production, distribution and vertical market applications.

Mapping vertical markets and applications (the presentational framework)

A less complex mapping structure was developed to provide a picture of software industry activities in vertical applications markets and show key dimensions of activity and capability. The pictorial presentation provides an indicative listing of software producers, defined by their primary activities and what they supply into selected vertical markets.

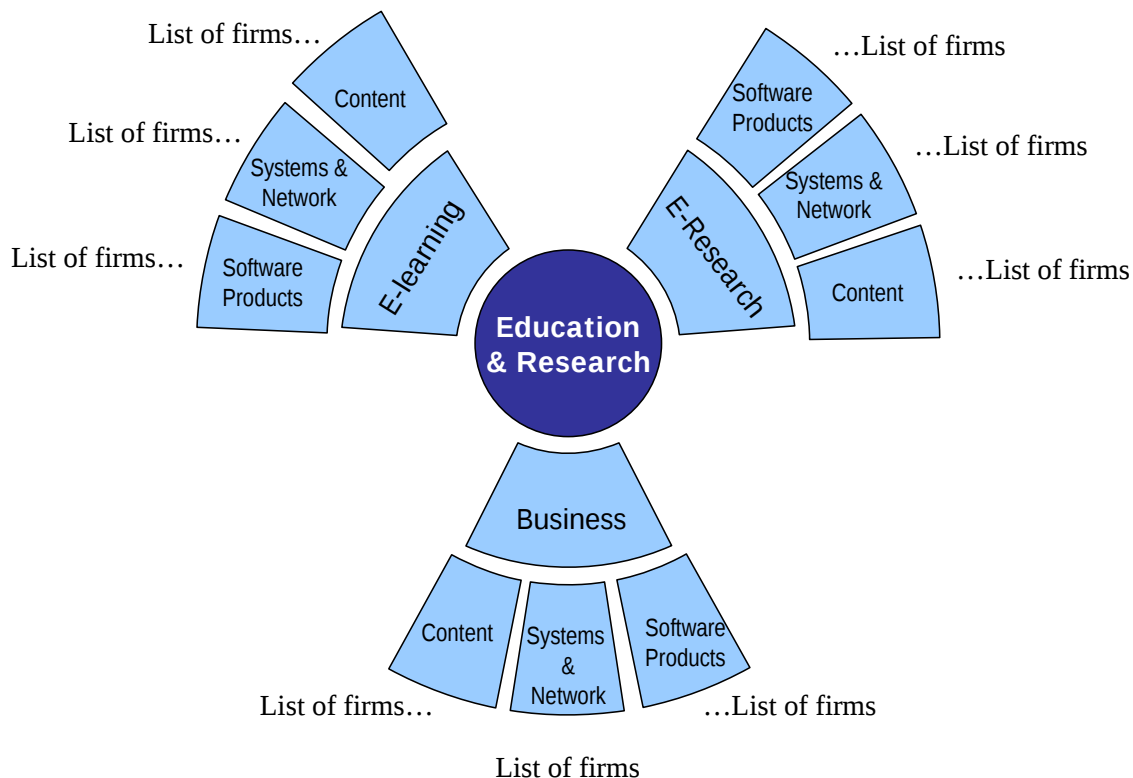
The population of firms represented on the maps cannot be exhaustive, but they are intended to be indicative of actors and significant activities. While multinational corporations (MNCs) are integral to the fabric of the Australian software production, the maps focus on Australian firms and the basis in Australia for sustainable growth of these software firms.

We developed a two-dimensional structure with four layers of branching for the selected target vertical markets (figure 3).

- The *vertical market* (e.g. education) is at the centre.
- The chosen *sub-sector drill-downs within that vertical market* (e.g. e-learning and e-research), along with ‘other applications’ targeting the vertical market are presented in the next level out.
- The next tier (i.e. branch or concentric circle) identifies the *primary product or service supplied* by the producer/distributor (e.g. ‘Software Products’, ‘Content & Access’ and ‘Systems, Network and Integration Services’, including customisation, integration, maintenance and support services).
- The outermost level *identifies indicative firms* supplying the products and services identified.

This approach is not only practical, but also offers the possibility for strategic focus and drill down while at the same time providing the framework for ongoing data collection and analysis to extend the scope, coverage and depth of the software mapping.

Figure 3. Vertical applications map (education & research example)



Source: CSES Analysis.

Limitations of the vertical market approach

In a study of software for specific vertical markets, there is an inevitable focus on the specialist software producers while non-specialist producers (e.g. multi product and service firms), in-house production (e.g. extensive development of content and tools within the sector for own use and sharing), and non-market production (e.g. freeware and open source/open access) receive less attention.

The focus on vertical software applications markets also tends to lead to a neglect of embedded software—be it embedded in hardware products, services or multimedia content. Given the extent of non-specialist, in-house and non-market software production in sectors

like education, health and government, and embedded software production across a range of industries, these limitations must be borne in mind when reading this report.

As a result, the mapping necessarily involves making a number of generalisations and simplifying assumptions. The categorisation of firms included should be taken as no more than indicative of part of their activities. Importantly, a significant number of key suppliers of software into vertical applications markets will be overlooked as a consequence of the relative neglect of non-specialist, multi-product firms, embedded software, in-house production and other non-market sourcing (e.g. shareware and ‘shared ware’, freeware, open source, etc).

In some market verticals (e.g. education, health and government) non-market and non-specialist software is likely to account for a significant share, if not the majority of software used (as noted above).

Mapping vertical markets and applications

The product system approach informing this study draws attention to a number of important features of software value or product systems.

Structure of the value or product system

Product or value systems vary in terms of their structure, with some exhibiting a concentration of power and value in specific parts of the system, specific activities and in some cases even specific actors. Because software tends to be deeply embedded in the activities and processes within product/value systems, the ways in which it is designed, developed, distributed and applied are affected by the power and value relationships within the system. As product/value systems become increasingly integrated and coordinated, this becomes an increasingly important aspect of software verticals.

It is common, for example, for the structure of particular product/value systems to influence the nature of software development and purchasing relations, distribution processes and mechanisms. There are cases where a particular type of actor in the product/value system controls a particular resource and/or takes a lead in development which becomes a key driver of the pace and direction of development. For example, in the context of the delivery of travel and tourism services, global reservations systems and global distribution systems, developed originally by airlines (e.g. SABRE, Amadeus, Galileo and Worldspan), form a key part of a system around which all other ICT developments must structure.

Another example common to a number of product/value systems is that of e-commerce and supply chain integration, within which the demands of major customers (e.g. automotive assemblers, major retailers, etc.) drive developments. Smaller users and suppliers along the supply chain (e.g. travel agents, automotive components suppliers, grocery suppliers, etc.) are often encouraged to adopt particular systems and solutions in order to integrate into the existing systems of the major players.

Smaller users and suppliers may even rely upon the major players for the supply of software and operational support services.

In other product/value systems key ‘gatekeepers’ play a central role, with supplier accreditation and integration crucial to vertical market access. In the government and defence

markets, education and health pre-qualification and accreditation play a vital role—with accreditation activities managed by lead customers and/or sometimes official independent regulatory authorities. In some cases, specific regulatory demands and regulated vertical market structures drive and shape development. The types of organisations having the gatekeeper function may vary between national markets, for example regulatory authorities (e.g. the Health Insurance Commission) play a crucial role in the Australian e-health market, while the major private medical benefits funds play that role in the US.

The common theme in all of these examples is that vertical market specific channels and mechanisms may constrain market access by smaller independent software developers, and/or major players may drive and shape developments (sometimes themselves competing as non-specialist suppliers) and act as ‘gatekeepers’ to vertical market access.

Nature of the value or product system

The nature of the system in terms of established and conventional practices, national customs and mores can influence several market verticals within individual countries.

Conventional practices in relation to arms-length purchasing and contracting, versus in-house development and provision (i.e. the conventions regarding the trade-off between markets and hierarchies) can influence vertical market opportunities. In some product/value systems the use of subcontracting and purchasing from specialist producers is a long standing practice, for example in the building and construction and the ICT industries (both software and services and electronics). In other industries it is more common for would-be customers to rely on internal resources and non-market sources to supply their needs, such as in the education and research and oil and gas industries.

Conventions and established practices are also important in cooperative/collaborative practices and mechanisms. In some product or value systems and related vertical markets cooperative and collaborative practices have been relatively rare and collaborative mechanism remain under-developed. In others, cooperative activities are widespread, collaboration common and there are well established mechanisms to support collaborative activities. These characteristics may reinforce or potentially distort purely market-based supply decisions.

The ICT and building and construction sectors are characterised by market based collaboration while collaboration is more often characteristically non-market in education and research. In some areas, such as health and logistics, cooperation and collaboration appears to be less developed despite extensive mechanisms for communication.

Stage of innovation and development

There is often high production and innovation complexity in the software product system, not only because a wide variety of distinct components, skills and knowledge inputs are involved, but also because large numbers of firms or different organisations often have to work together in production (e.g. prime contractors and systems integrators, users, buyers, other suppliers, small and medium sized enterprises, government agencies and regulators). *In such systems, there tends to be two phases and forms of innovation:*

- *the development of new systems architectures* prior to, and during the early phases of commercialisation, wherein architectural designs are powerfully influenced by system suppliers, regulators, standards-making bodies and large users; and
- *a phase of new product generation*, wherein the rate of component and systemic innovation increases and successive new products and components are introduced, without fundamentally altering the established architectural design.⁵

Product or value systems, and related vertical applications markets, vary in terms of the stage of innovation reached. In such areas as e-health, e-learning and e-research, many of the standards and 'systems architectures' are still being worked through. Whereas, in such areas as e-government, there is a more established base upon which to build. The nature and pace of innovation will be different in such cases, as will the key innovation linkages.

Innovation linkages

Software product systems and related vertical markets exhibit a range of key innovation linkages, including:

- *user-producer linkages*, with innovation driven from the demand-side by leading and demanding customers (e.g. large systems integrators in ICTs, national and state governments in health or education);
- *producer-producer linkages*, with innovation driven by cross-fertilisation and demands for the integration of systems components (e.g. defence, e-learning and e-research content and access systems);
- *supplier-producer linkages*, with innovation driven by the emergence of new technical possibilities and price points (e.g. rapid development of hardware or systems software); and
- *regulator-producer linkages*, with innovation driven by the emergence of new standards and standards agreements, or by the demand to meet new, more stringent accreditation criteria.

There are also some linkages to research actors and activities.

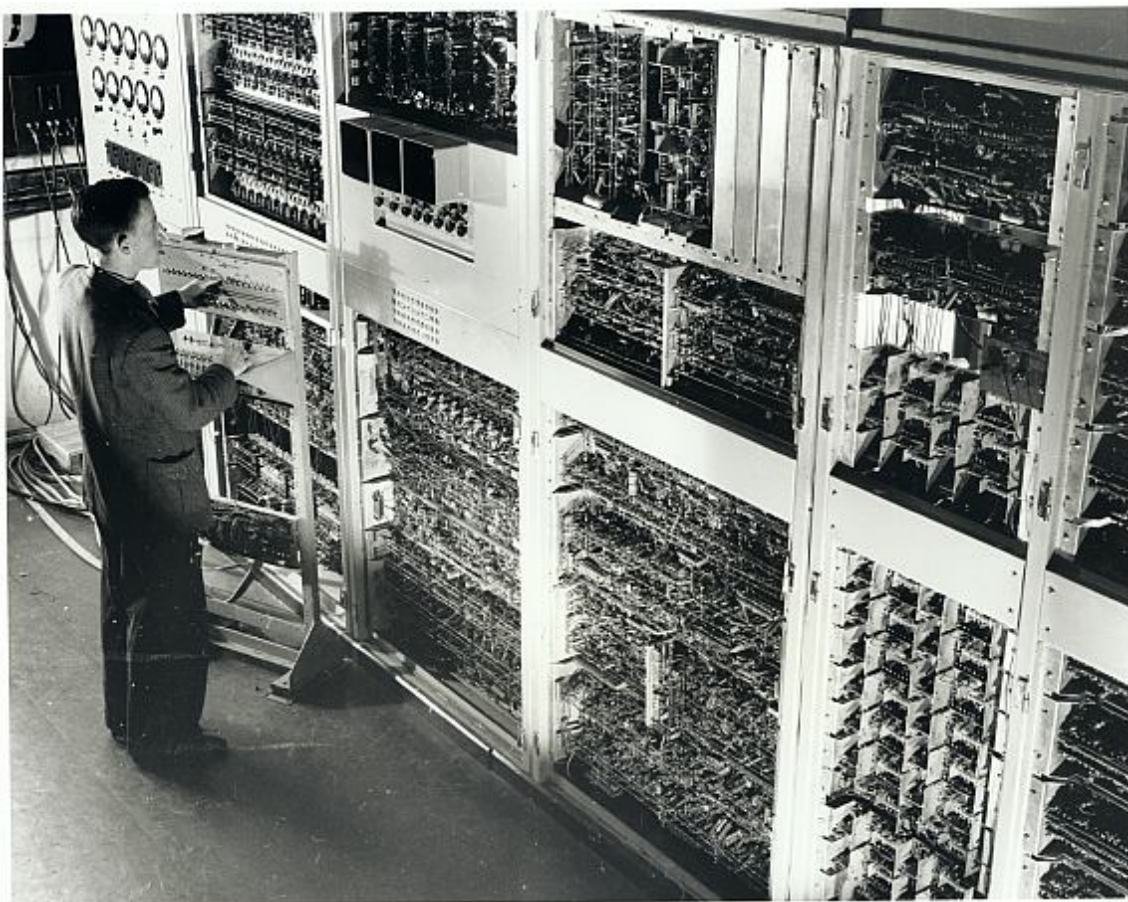
The locus and concentration of power, conventional practices and mechanisms, and stage of innovation development will largely determine which of these forms of innovation linkages predominates at particular times and/or within particular vertical markets. A small survey of Australian firms indicated that there is generally a heavy dependency on major clients for both innovation and as a channel to market. Almost 50% of the software firms surveyed nominated marketing as the capability most needed for the future, ahead of skills (29%) and R&D and new product development (9.5%).⁶

Map of the software industry

Evolution of the software industry in Australia

Australia has been involved in the provision of information technology services since the invention of the computer, and was a pioneer user of early telephone and telegraph systems. Australia's first electronic computer, CSIRAC, was designed and built in Australia in 1949, the same year as the first IBM. This computer, the oldest intact digital computer in the world, can now be seen at Museum Victoria.

Figure 4. CSIRAC: Australia's first computer



Source

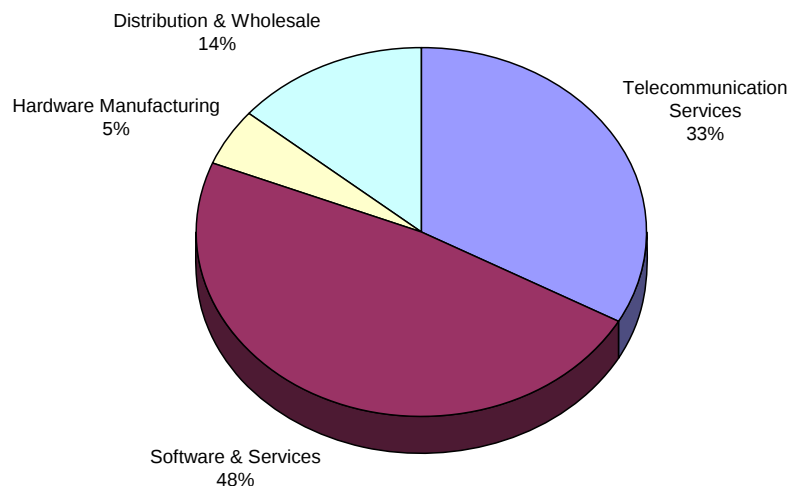
e: CSIRO (<http://www.cip.csiro.au/History/CSIRAC1.htm>).

Software and services firms emerged in Australia, as they did elsewhere, in the late 1950s and early 1960s, with an explosion of growth in the 1970s. IT services bureaux have been operating in Australia since that time, and a number of software and services firms in Australia have a 30–40 year history and a track record of satisfied customers, both Australian and international. Therefore, unlike many other parts of the world, Australia can truly claim to

have more than 100 years experience in telecommunications, more than 50 years experience in information technology, and more than 40 years experience in commercial software development.

When they developed Australia's first computers in the late 1940s and early 1950s, scientists such as Trevor Pearcey and John Bennett were just as much software programmers as they were engineers. However, software was not distinguished commercially from the hardware that carried it until the early 1970s. In the 1969 industry 'bible', there are 76 pages concerning hardware in the index but only one mention of software.⁷ Today, Australia's ICT industry is dominated by computer and communications services firms, rather than by hardware developers and manufacturers. Almost half of ICT industry employment is found in the software and services sector.⁸

Figure 5. Australian ICT industry structure (employment shares)



Source: Whitehorse Strategic Group industry model 2004 derived from survey data and ABS.

Software is an integral and strategic part of all modern industry and commerce. The Framework for the Future report, *Enabling our future*,⁹ concluded that development of the ICT industry needs to be “set in the broader context of ICT as an enabling technology which underpins Australia's development as an ‘information’ or ‘knowledge economy’”.

Software enhances the broad information capability in industry, government and many human activities. It increases the productivity of all industries and is increasingly embedded in goods and services and it is critical to the achievement of Australia's economic goals, to national security, to dealing with demographic change, environmental management, education and health. It is also integral to Australia's capacity to innovate and to the performance of research itself.

Australia also needs domestic software capability to remain competitive and to address our national challenges. Some recent research into the impact of ICT on productivity provides an indication of the importance of software to the competitiveness of Australian industry.

The Productivity Commission concluded in a 2004 paper¹⁰ ‘There is sufficient circumstantial and formal evidence to conclude that an increase in ICT use has lifted Australia’s multi-factor productivity growth’. The report went on to say:

The same industries have shown the combination of higher ICT use and productivity acceleration in both the United States and Australia. US industries that have been high on the uptake of ICT and that have also shown strong productivity improvements include financial intermediation, distribution (wholesale and retail trade) and business services.

In Australia, the positive association between higher ICT use and productivity acceleration is most evident in Finance & insurance and, to a lesser degree, in Wholesale trade.

While the commission assumed that the impact of ICT hardware on productivity was due to imported product, it did not examine the impact of Australian software.

The Howard Partner’s 2005 *Digital factories* report¹¹ included an exploration of this issue in the context of the Australian manufacturing sector. It found that some software used was derived from Australia, and suggested that much of the competitive advantage in Australia’s manufacturing sector can be attributed to business acumen in being able to use ICT strategically and to Australia’s software capability.

The report concluded that ‘software underlies every aspect of productivity and performance improvement. Australian manufacturing businesses need access to software that reflects the research and development (R&D) input of globally oriented software firms but is relevant and applicable to local conditions. This requires a strong Australian software development sector that is attuned to Australian manufacturing needs and a services sector that has both national and international linkages’.

According to *Enabling our future*, having an ICT development and production capability creates a symbiotic relationship between users and producers with the level of sophistication of users enhanced by the presence of producers of ICT goods and services.¹² Software contributes to Australia’s ability to buy goods and services in the global market – software provides a significant source of export revenue, and many other exported goods and services contain embedded software components. A domestic ICT capability is also more likely to develop ICT goods and services targeted at Australia’s specific needs and challenges.

Software producers

This section maps the software industry. It begins with a statistical overview of the Australian software industry and then presents a brief software production analysis. It corresponds to the left-hand box of the software product system map (i.e. software producers).

Statistical overview of the software industry

There are few extensive data sources of the software industry per se and this report relies primarily on the survey of ICT specialist firms undertaken at two year intervals by the Australian Bureau of Statistics (ABS)¹³, and the six-monthly ICT industry survey and industry model by Whitehorse Strategic Group Limited, referred to as the Whitehorse 'top 250' (T250). The limited data available on the software industry has necessitated the use, in some cases, of data that is not as up-to-date as we would have liked.

The ABS and other analysts divide the Australian ICT industries into a number of industry sectors, based upon the primary role of the firm (or in a limited number of cases a major business unit of a larger firm). ABS applies four primary groupings to the ICT industry (hardware manufacturers, telecommunications service providers, computer service providers and wholesalers), while Whitehorse¹⁴ and CIIER apply five, which in turn are subcategorised into 14 subsectors. Nine of these subsectors, including software producers, are within the ABS category of computer service providers, whilst many software distributors are grouped within the wholesalers industry category.

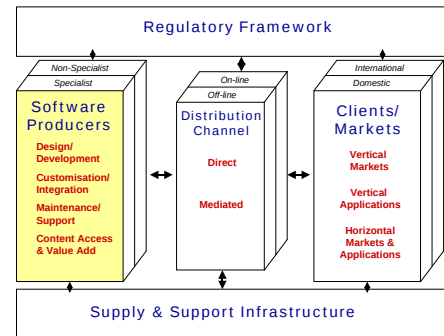


Table 1 **Statistical model**

<i>ABS ICT Industry Sector</i>	<i>CIIER/Whitehorse ICT Industry Sector</i>	<i>CIIER/Whitehorse ICT Industry Sub-Sector</i>
Computer services	Consulting	IT Education and Training. Strategy and planning. Personnel and contract staff. Other services.
	Software	Software support and maintenance. Software product (package) development. Facilities management and outsourcing. Content and Web-based services. Systems and network engineering and integration.
Manufacturing	Hardware	ICT Hardware and components.
Wholesale trade	Distribution	Wholesale Distribution of Hardware or Software. Retail Distribution of Hardware or Software.
Telecommunication services	Telecommunications	Telecomms infrastructure and basic services. Content and value add.

Source: CIIER Analysis.

The Whitehorse survey and modelling process

The Whitehorse Top 250 database contains detailed longitudinal data on more than 700 firms employing 131 000 staff, earning \$61 billion in revenue and spending \$597 million on R&D, (as at June 2005).

Software and services survey base

There are 405 firms in the Whitehorse T250 database categorised as predominately in the software and services sector. This survey sample (June 2005), represents around 40 000 to 45 000 employees and around \$12 billion revenue. According to ABS data (2002–03), the employment in the Australian computer services was around 107,000 in 2002–03 and the industry revenue was \$17 billion.

On the basis of the ABS data, the Whitehorse database and model represents a detailed sample of nearly half of all employment in this sector, and close to 70% of revenue. Whitehorse maintains consistency of the sampling of firms with the ABS and updated its 2003–04 models to reflect the ABS's new survey frame which was introduced for the 2002–03 ICT industry survey.¹⁵

The Australian software and services industry—key statistics

World software market

The major categories of software have historically been categorised as customised software, systems infrastructure software, applications tools software and applications software.

Increasingly, however, such distinctions have been extended to more meaningful categories, and the most recent, industry accepted, global evaluation¹⁶ defines software as ‘the total value of purchased or leased operating systems, programming tools, utilities, applications, and games, and the total value of outsourced software development such as computer programming, web development, and application development’.

Operating systems and utilities consist of proprietary and some generic (open) software to operate computers and the networks connecting them. This market is dominated globally by the equipment suppliers (IBM, HP, Cisco, etc) and specialist multinational players (Microsoft etc). Some of the companies with significant global market shares are listed below.

- System-level: Microsoft (Windows), IBM and HP
- System management: Computer Assoc, IBM, HP and Candle
- Network management: Bellcare, IBM, Cisco and Network Associates
- Middleware: BEA, WebMethods and IBM
- Serverware: Netscape, EMC and Sterling
- Security software: Network Associates, Symantec and Verisign.

Programming tools provide information access tools and programmer development tools to assist developers in writing software. Some of the major international suppliers are listed below.

- Database management systems (DBMs): Oracle, IBM and BMC
- Information access tools: Microsoft, IBM and SAS
- Programming development tools: Microsoft, Computer Associates and Oracle
- Development lifecycle management: Compuware IBM

Applications are software products that manage organisation tasks offering productivity-enhancing benefits to end-users through either horizontal or vertical industry applications.

Horizontal industry applications have historically offered greater sales volumes than vertical industry ones. They are mostly supplied as branded products by large multinational companies, some of which operate in more than one of the software subcategories.

- ERP (enterprise resource planning): SAP, Peoplesoft, Oracle and JDE
- CRM (customer relationship management): Siebel, Peoplesoft and Oracle
- Supply chain and workforce productivity: SAP, i2 technologies and manugistics
- Consumer: Microsoft and Electronic Arts (games).

Vertical industry applications—provide solutions to the unique needs of different industry sectors, eg Finance, Telecommunications, Health and Medical.

Software, defined this way, represents 32.4% of the total ICT world spend, allocated 68% to products and 32% to services.

Table 2 ICT world market 2004–08

ICT Market Category	2004	2005*	2006*	2007*	2008*
		\$US	Billion		
Communications services	\$1,404.50	\$1,514.05	\$1,632.15	\$1,759.45	\$1,896.69
Software	\$583.00	\$633.72	\$688.85	\$748.79	\$813.93
Hardware	\$424.00	\$451.56	\$480.91	\$512.17	\$545.46
ICT services	\$238.50	\$263.30	\$290.69	\$320.92	\$354.29

* Projected market size

Source: WITSA Digital Planet 2004

WITSA projects the computer services and software sectors will have the greatest increases over the next four years within the global ICT market, with 10.4% and 8.7% compound average growth rate respectively. This indicates a strengthening and growing software global market.

The Australian software market

Market quantification changes rapidly, and is defined in a number of different ways. WITSA estimated the Australian software spend in 2004 at USD 5.9 billion for products, and a further USD 3 billion for services, (approximately AUD 13 billion in total), having grown more from USD 5.1 billion for products and USD 2.4 billion for services in 2001. Growth to 2007 is projected to deliver a market approaching \$US6.6 billion for products and USD 3.9 billion for services.

ABS has estimated that the total revenue earned by the computer services industry during 2002–03 was AUD17 billion, with AUD 736 million (4.3%) of this derived from packaged software (including licence fees).¹⁷ The computer service industry earns other types of revenue as well, so AUD 736 million represents around 8% of revenue from the identifiable software and services revenue items for the computer services sector. For purposes of comparison, this is equivalent to around 28% of the AUD 2.6 billion revenue earned by wholesale traders for the sale of packaged and customised software.

ABS also estimate a further AUD 3.96 billion industry earnings for customised software and services. The choice to purchase products or services is often determined by the client, so a portion of this expenditure may also be relevant to the market for software developers.

Software exports

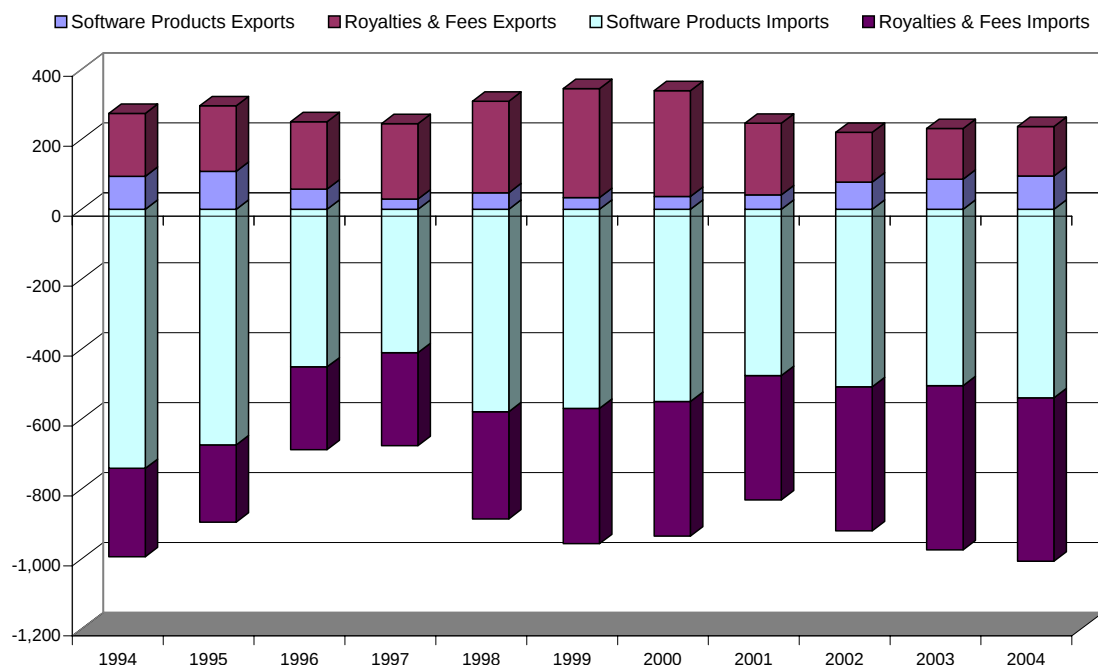
There are many problems associated with tracking software imports and exports in trade in national statistics. The approach used in this analysis is to track trade in the physical supports for software (e.g. magnetic discs, tapes and other recorded media) and in the payments made in respect of software related royalties and licence fees.

Tracking the physical supports for software (i.e. software products) has significant limitations. First, as border valuations are based on the physical support media, the value of the software traded is likely to be significantly understated. Second, the bundling of software with hardware leads to significant mismeasurement (likely overstating equipment trade and understating software trade). Third, trade statistics do not measure the value of copyright works sold in foreign markets. Fourth, trade statistics do not measure the value of software electronically transmitted across borders —an emerging business model for software delivery and accounts for a rapidly increasing share of cross-border trade. Nor do the statistics capture software delivered as a service by applications services providers (ASPs).¹⁸

Tracking software related royalty and licence fee payments complements software products trade statistics, as some of the elements of the trade missed in trade statistics will be captured in royalty and license fee payments (e.g. embedded software). Nevertheless, taken together, the measured trade in software products and payments of software related royalties and license fees provide an indicative window on Australia's software trade.

Whilst software product exports have risen slightly over the last few years, there has been a decline in the software related royalty fee and license payments to Australian firms (i.e. exports). This contrasts with recent increases in outgoing software related royalty fee and license payments (i.e. imports). The apparent trend decline in total trade in software products over recent years may also reflect the use of online software delivery alternatives and increased embedding of software within other exported products and services.

Figure 6. Software imports and exports, 1994 to 2004 (AUDm)



Notes: Software products include recorded and recordable media of the types suitable for software. Software royalties & fees for 2003–04 are estimated, based on software share of total royalties and license fees in previous year. All data are current prices.

Sources: ABS (various years) *Balance of payments and international investment positions, Australia*, Cat No 5363.0, Canberra; ABS (various years) *International trade in goods and services, Australia*, Cat No 5368.0, Canberra; ABS (various years) *Balance of payments and international investment positions, Australia*, Cat No 5320.0, Canberra; DFAT (various years) *Trade in services Australia*, Department of Foreign Affairs and Trade, Canberra; and ABS unpublished data. CSES Analysis.

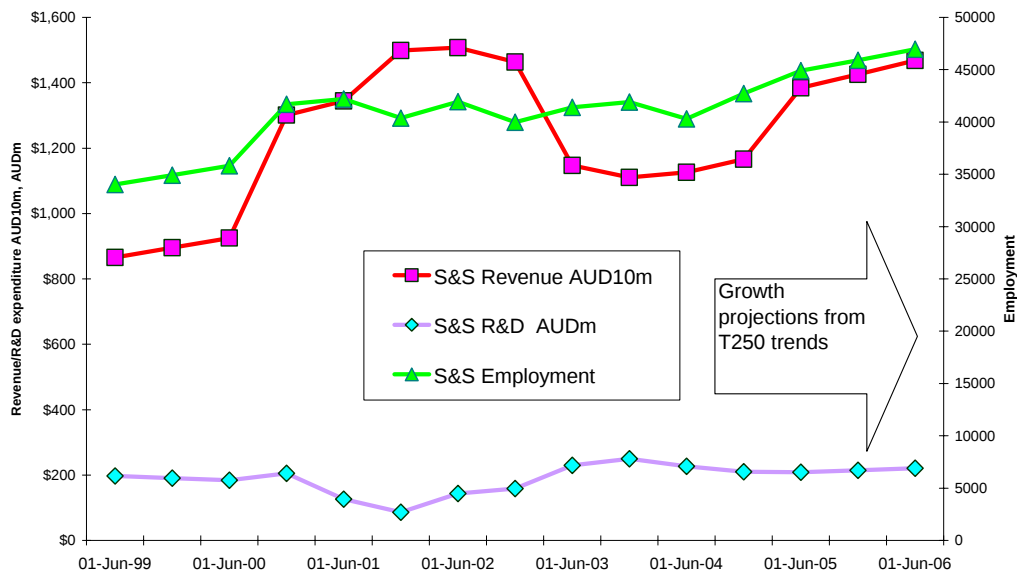
Software and services employment, revenue and research expenditure

Whilst the bulk of the employment is within larger software and services companies, there is a significant number of smaller and micro firms operating in the industry. Various estimates¹⁹ suggest between 18 000 and 22 000 smaller ICT firms exist, although some of these are simply registered entities providing single person contracted services. According to the 2002–03 ABS ICT industry survey, 85% of firms had fewer than 5 employees and around 550 computer services companies had 20 or more staff.²⁰

Figure 7 tracks employment, revenue and research expenditure of the software firms within the Whitehorse survey group.

Research expenditure provides an indication of industry's forward intentions for new products. According to the Whitehorse T250 data, software and services R&D spend has been relatively static in real dollar terms since June 1999, and appears unlikely to grow unless some major change occurs that would cause a surge in research activity. This does not bode well for expansion of software product offerings, since they naturally follow behind software research.

Figure 7. Trends in software and services employment, revenue and R&D, 1999 to 2004



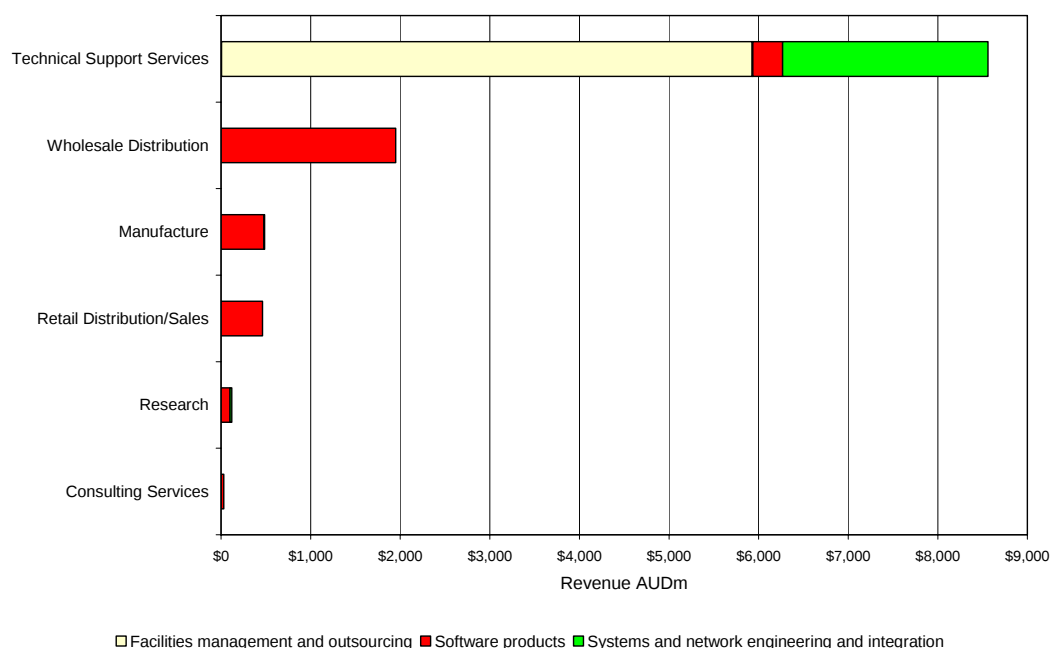
Source: Whitehorse T250 Survey group Dec 2004

A detailed examination of the revenue of firms in the T250 survey, analysed by each firm's major product or service (excluding telecommunications and hardware distribution) reveals several changes that have taken place in the industry's revenue structure. Since July 2003, systems integration service revenue within this group has diminished as a revenue stream from nearly 25% of the total market revenue to just over 19%, while strategy and planning has increased from under 4% to over 5%.

This may indicate a move away from the commissioning of large, in-house projects to a more strategic approach and increased software product sourcing. Facilities management and outsourcing, while retaining its significant 45% of revenue, has hardly changed since June 2003.

Software products revenue within this group has increased from 21% to nearly 26% over the same period, and is the only segment that has increased for three surveys in a row. This may indicate that the Australian software products market will continue to improve, as more software solutions are supplied through a product rather than a service business model.

Figure 8. Indicative revenues of software and services firms by major product/service, 2004



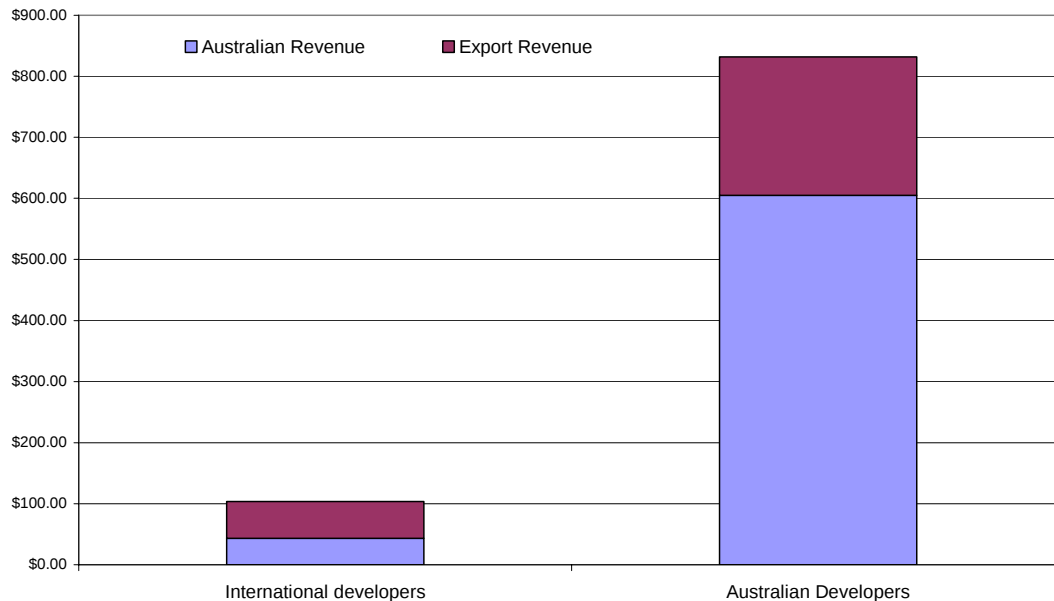
Source: Whitehorse T250 survey group.

However, a more detailed analysis of the revenue of firms in the December 2004 Whitehorse survey indicates that the businesses operating primarily in technical support services (large, multinational, outsourcers, integrators, and a number of smaller software support firms) gained nearly AUD 8.6 billion of the AUD 11.6 billion revenue in this survey group, and most came from the provision of facilities management and outsourcing or systems integration. The next largest revenue group was wholesale distributors, who mostly handle imported products. True software manufacturers and researchers in the survey group gained a very small part of the Australian revenue in this sector, and appear to be operating in a domestic submarket of under AUD 700 million per annum (for the survey group).

Implications for the software market model

Taking the detailed Whitehorse December 2004 survey sample data above, and extrapolating this to the software industry model, CIIER estimates that the total domestic and export software product market supported from Australia is approximately AUD 934 million, with international firms currently responsible for AUD 103 million, leaving AUD 831 million of the combined domestic and export market divided among the domestic software producers (see figure 9). Some AUD 605 million of the Australian domestic market is supplied by locally owned domestic software product developers.

Figure 9. Revenue from software products, 2004 (AUDm)



Source: Whitehorse T250 model, IDC, CSES, TradeData and ABS.

Box 1 How many firms can be 'grown' from Australia?

On the basis of a domestic software product market served by Australian producers of about \$800 million annually and ignoring export revenue, a simplistic equation shows that Australia could support a maximum of 400 specialist firms with an average annual domestic revenue base of \$2 million.

Clearly the export market is the key to growth for Australian firms. However firms seeking to export usually require a higher level of domestic revenue to maintain necessary levels of staff and export development activities. A more realistic evaluation is that the current domestic market, as currently structured, could support up to 80 specialist software firms, with an average \$10 million per annum revenue. This revenue would sustain some capacity to supply international market growth.

Most of the Australian \$5.9 billion software product market is supplied by imported product and Australian owned distributors earn a significant proportion of revenue by distributing imported products within Australia. If these distributors were to shift to a more significant focus on Australian products, some of this market share may be unlocked for Australian producers.

The current limited domestic market for software producers reinforces the need for export market growth to sustain the growth of a larger software products industry.

Market role of multinational software suppliers

As structural statistics show, the Australian domestic software market is dominated by sales of imported packaged software with the major MNCs operating either through wholly owned subsidiaries or through distributors and systems integrators. Smaller multinationals tend to use distributors more often than the larger companies, however some operate their own branches

in Australia, which may also act as regional headquarters for the Asia Pacific, for example Front Range, Bentley and Citrix.

According to Whitehorse21, fifteen MNC software vendors alone accounted for 16.5% (AUD 2 billion) of the estimated AUD 12.6 billion Australian domestic software product and services sales in 2005. Some of the major software multinationals operating in Australia are listed here.

ADC Software Systems Aust	NCR Australia
Citrix Systems Australia	Nortel Networks
Cognos Pty Ltd	Oracle Corporation Australia Pty Ltd
Computer Associates Pty Ltd	SAP Australia Pty Ltd
Compuware Asia Pacific Pty Ltd	SAS Institute Australia Pty Ltd
Microsoft	Symantec Australia Pty Ltd

In addition to these pure software vendors, a number of MNCs operating in Australia are multi-product suppliers selling particular mixes of software, hardware, and services. Some of them have significant software product revenues as part of this mix. CIER estimates, based upon the 'normal' revenue mix of software and hardware, that these vendors provide at least a further AUD 2.4 billion in software/hardware products and AUD1 billion in services. A non-exhaustive list of these multi-product multinationals includes:

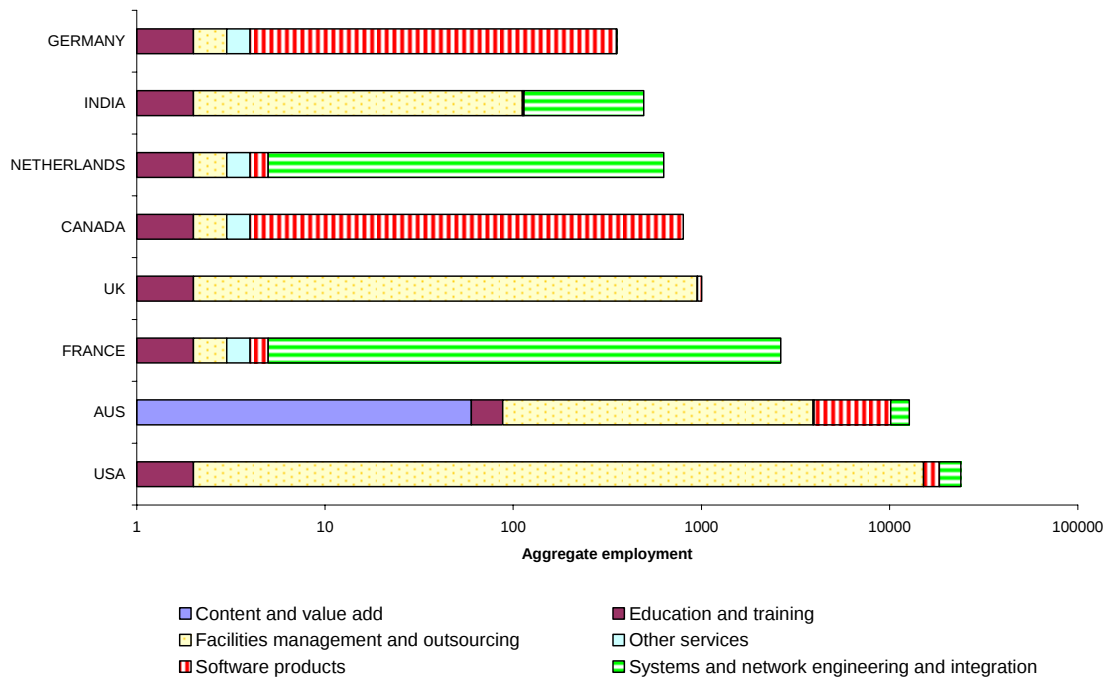
Acer Computer Australia Pty Ltd	Intel Australia Pty Ltd
Digiland P/L	LogicaCMG
Dimension Data Australia Pty Ltd	Nokia Networks Australia
EDS (Australia) Pty Ltd	Satyam Computer Services
EMC Corporation	Sun Microsystems Australia Pty Ltd
Hewlett-Packard Australia	Synnex Australia Pty Ltd
IBM Australia Ltd	Tech Pacific

A further grouping of MNCs operate in the systems integration and development field, and account for a further AUD 2.6 billion software and services revenue in 2005. They include such companies as the following.

Accenture Australia Ltd	GFK Marketing Services Australia Pty Ltd
ADI Limited	Infosys Technologies (Australia) Pty Ltd
AMS Management Systems Australia	Kanbay Pty Ltd
Cap Gemini Ernst & Young	Oxygen Business Solutions
CSC Australia	Ripple Systems Pty Ltd
Getronics Australia Pty Ltd	Unisys Australia Limited

The aggregate Australian software and services revenue, just of the 45 MNCs listed above, is therefore estimated at nearly 65% (AUD 8 billion) of the total Australian software and services spend.

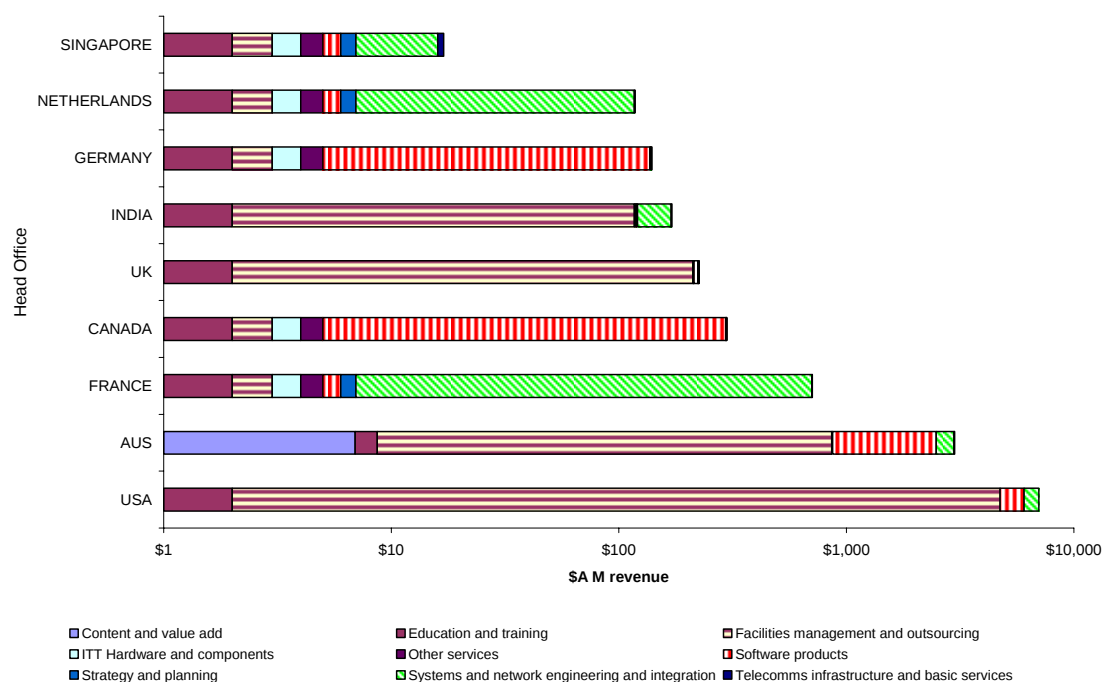
Figure 10. Australian software and services employment by head Office location, December 2004



Source: Whitehorse T250.

Figure 10 shows employment in the survey sample of software and services firms operating in Australia (T250 data) and indicates the multinational nature of the industry. Total Australian employment in the software and services sector is understated in this sample, due to the many smaller Australian owned firms. Many of the major segments of the Australian software market are dominated by multinational suppliers. Figure 11 shows the revenue distribution for the same survey sample, with MNCs earning over two-thirds of software and services revenue in Australia. Data for figures 10 and 11 is in the annex to part A.

Figure 11. Australian software and services revenue by product / service, and head office location, December 2004



Source

: Whitehorse T250.

While there is some potential for some of the MNCs to expand activities in Australia and to engage strategically with the Australian industry and innovation base, their primary driver is commercial exploitation of the Australian market within the context of their global operations. Firms fund expansion from capital and retained profits and with the control over the foreign-owned MNC's destiny not held locally, CIIER considers that expansion, research commitment and training may be less likely to occur than in Australian-owned companies. In more difficult times, experience shows that overseas companies can rationalise their activities by reducing or closing operations overseas, particularly those that are less strategic in nature. For example, over 40% of a sample of 120 ICT business closures in Australia following the 'dot-bomb' ICT stock market decline in 2001–02 were overseas owned companies, mostly engaged in software distribution.²²

Innovation as a basis for growth

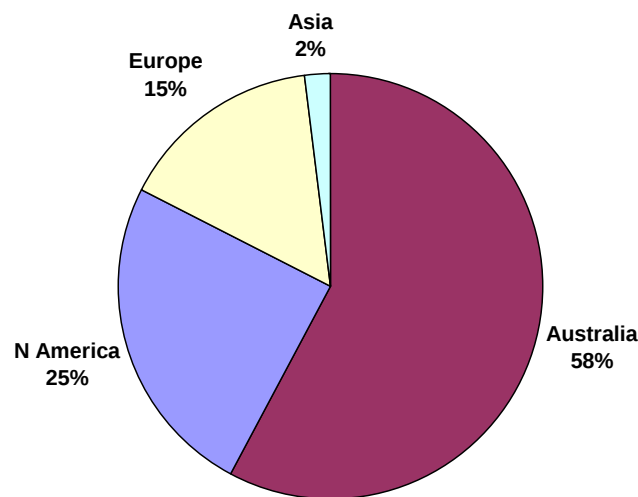
In their report, *Australia—winning in the global ICT industry*, McKinsey & Company commented on the importance of undertaking world-class innovation in Australia.

Australia will only be successful in the (global) ICT industry to the extent that it drives world-class innovation. ICT R&D is typically carried out over a medium-term timeframe and usually has uncertain commercial outcomes. Collaboration across adjacent sectors to build scale, and even collaboration among competitors, is sometimes required.

Australian domestic software and services firms invest relatively heavily on R&D. The chart below may understate the relative size of the Australian proportion, since it is derived from survey respondents only and is focused on larger companies. Nevertheless, even on this limited data, MNCs committed around 1.8% of their revenue to R&D, compared to 8.6% for the Australian owned companies in the same sample group.

This would suggest that MNCs, while still contributing a useful amount of software research, commit a lower proportion of their Australian revenue to developing and exporting software products from Australia than do Australian owned firms.

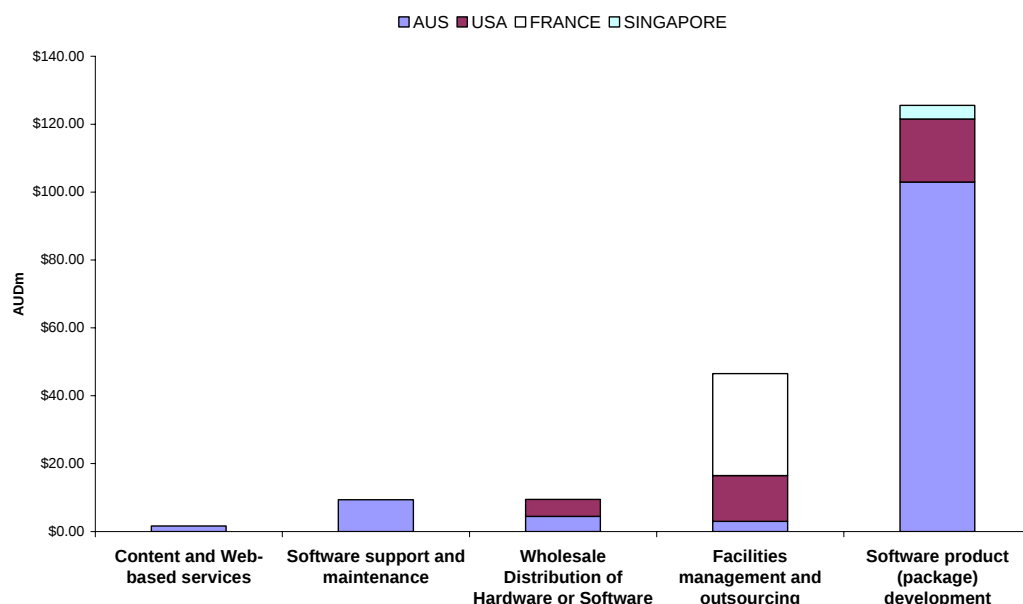
Figure 12. R&D expenditure by software and services firms in Australia, by country and region of origin, 2004



Source: Whitehorse T250.

This difference is further reinforced by analysis of the T250 database with respect to R&D performance in the industry subsectors.

Figure 13. R&D by primary software activity of software and services firms by selected countries of origin



Source: Whitehorse T250 survey Dec 2004.

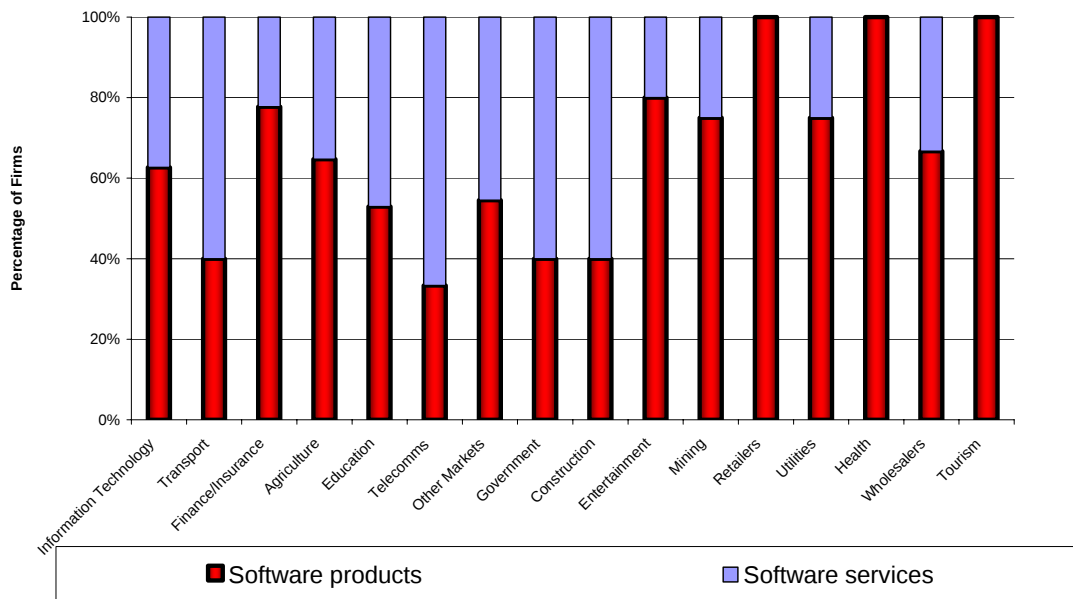
The T250 data show that software products firms (predominately Australian owned) perform the majority of software R&D. The firms providing facilities management and outsourcing (predominately internationally owned MNCs) while earning the majority of software and services sector revenue, perform relatively little R&D on software products or services. Nevertheless, a number of MNCs contribute significantly to Australian R&D and this contribution is explored further in the 'Software markets' chapter later in this report.

Client markets

The Whitehorse T250 survey collects data on all the client markets for the sample firms, with firms able to specify up to 16 markets. Figure 14 shows prime client market selection by the software and services firms, and indicates strong differences between the software product/service balance in the client markets.

The analysis shows that the retail, health and tourism sectors are serviced almost entirely by product-focused firms. All other markets are supplied by both software product and services firms, with companies that select telecommunications, transport, construction and government being predominantly orientated towards services rather than products. (The survey vehicle did not include manufacturing in the list of markets.)

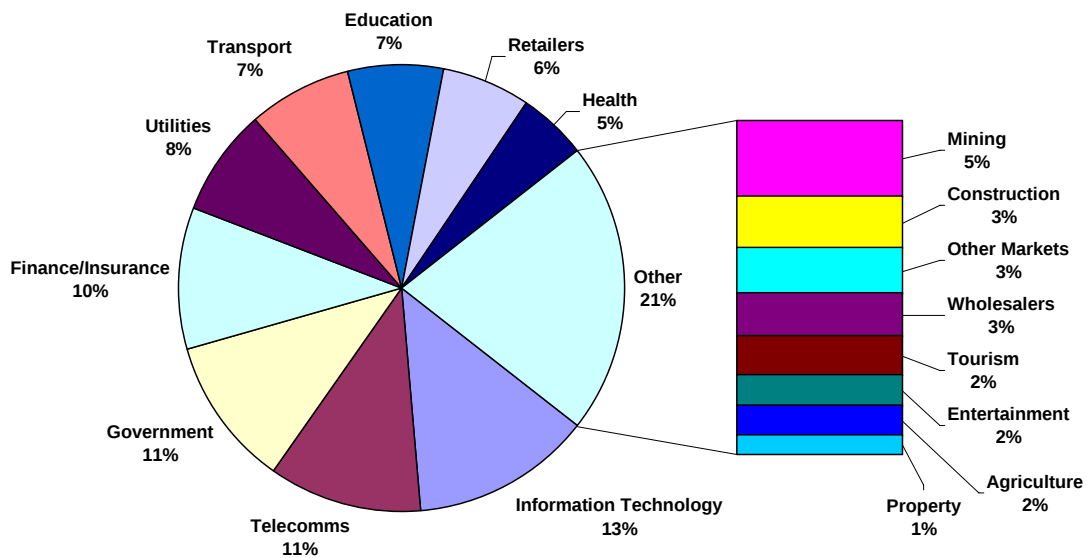
Figure 14. Primary markets of software and services firms in T250



Source: Whitehorse T250.

The subsequent chart shows all of the markets that were individually selected by software and services firms. It reveals that many of the firms selected multiple markets, and that a number of key markets are in second or third place.

Figure 15. All markets selected by software and services firms in T250, 2004

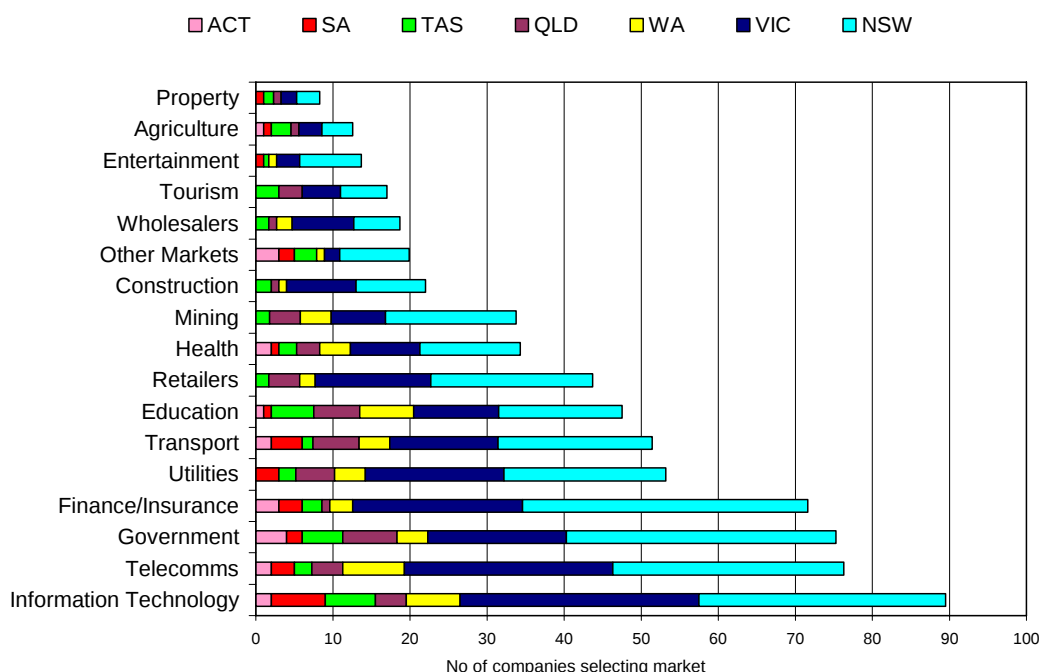


Source

e: Whitehorse T250.

It has been suggested during the consultation process that some states have advantages in terms of particular markets. Our analysis supports this, as the ratio for various market selections indexed by the location of head office of the firm concerned, shows a variable distribution pattern in which states other than Victoria and NSW clearly have some significant focus on particular markets.

Figure 16. Market by head office location of software and services firms in T250, 2004



Source: Whitehorse T250.

The chart above shows target markets selected by companies headquartered in the various states. Whilst this does not, of course, equate to market share, as one or two large companies in a particular market may have a disproportionate impact upon the total market, it shows the relative concentration of company effort on particular markets in each of the states. Markets that are targeted by companies from the widest range of states and territories include: information technology (including telecommunications), finance/insurance, transport, government, education and health. The markets that are serviced by firms from a smaller number of States are mining, retail, wholesalers, tourism and construction. The data table is presented in the annex to part A of this report.

Summary of software industry statistics

Both in revenue and employment terms, dedicated specialist software developers, while generating a significant contribution to Australia's ICT export revenue, are a small proportion of the total ICT industry.

Based upon a number of the previously identified sources and models, we estimate that the software product (software product developers and distributors) industry sector in 2004 employed around 17 000 staff, out of a total software and services workforce of 106 500. We estimate that it is supported by some 6800 development staff and earns \$2.7 billion a year, of which \$831 million per year goes to Australian-owned developers.

Export markets account for \$286 million of this product revenue with \$226 million going back to the Australian owned software developers, and the software product industry sector spends \$66 million a year on R&D.²³

Domestically developed software captures just 17% of the AUD3.6 billion domestic market revenue for all software products, and less than 5% of the total software and services domestic revenue in Australia of AUD 12.6 billion. The vast majority of the balance remains with the computer services firms (i.e. integrators and outsourcers) or is absorbed at the wholesale and retail level by distributors, many of which are the branch offices of international firms.

This data is explored more fully in the following sections.

Table 3 Software employment, revenues & R&D expenditures (AUDm)

	Employment	Australian revenue (AUDm)	Product export revenue (AUDm)	Total revenue (AUDm)	R&D (AUDm)
International developer	650	43	60	103	10
Australian developer	6,200	605	226	831	38
Subtotal developers	6850	648	286	934	48
International distributor	7,300	1,355		1,355	13
Australian distributor	3,000	433		433	5
Subtotal developers and distributors of software products	17,150	2,436	286	2,722	66
Internationally owned software services	66,550	7,962	NA		
Australian-owned software services	22,800	2,227	NA		
Subtotal software services	89,350	10,189			
International software products retail market share		1,873			
Australian-owned software products retail market share		1,753			
Software products & royalties net revenue		3,627	286	3,913	
International software and services total	74,500	9,360			89
Australian owned software and services total	32,000	3,265			121
Software & services total	106,500	12,625	1,223	13,848	210

Source: Model derived from Whitehorse/CSES TradeData/IDC/ABS.

WITSA estimated a \$534 billion world market for software and \$238.5 billion market for IT services, and predicted strong market growth for software. If the Australian and international markets were to increase their focus on software product, CIIER considers that this could potentially lead to faster growth of the Australian software product sector.

Australia appears to have an adequate pool of skills to accommodate such growth, for example through changing in the job focus of some of the more than 100 000 people

employed in the software and services sector, or of the many ICT professionals employed as software developers in other industries.

Software production analysis

This section explores Australia's software production capacity, strengths and weaknesses, examining capabilities and areas of focus.

Software product development outside mainstream ICT

The analysis above has concentrated on dedicated ICT industry participants. However, in a recent report Sensis has estimated that 11% of SMEs producing ICT were specialist ICT firms—many more firms were producing ICT outside the industry than in it.²⁴ Only 26% of the total value of ICT produced by SMEs was from the ICT sector.

We considered the findings of this report, in particular, whether there may be a significant amount of 'hidden' software product, embedded within software development, that could, if marketed, provide additional revenue for the Australian software industry, or there could be a possible additional domestic market, if the software requirement was supplied as domestic product instead of being developed to specific requirement.

The Sensis analysis, however, focused on whether firms produced ICT goods and services, rather than specifically identifying software products. (In the survey, the software category among the ICT goods and services was for 'packaged and customised software'.)

The Sensis report also explored the tasks performed by employees dedicated to ICT tasks within the ICT producers, and found that less than 10% listed 'software installation/preparing/writing' as the main task of such staff (which also includes maintenance tasks). For comparison, 'looking after server/systems' was listed as the primary task by 25% of the firms with dedicated ICT staff, 10% listed 'offering advice/consultancy' and 11% 'designing and updating websites', all of which are mainly maintenance functions.

We consider that the software development activity found by the Sensis survey does not represent a substantial 'hidden' pool of software developers.

Regardless of the specific levels of software development outside the mainstream, while it is true that some software development may be translated into marketable software product, a significant amount of software development will not. The reasons for this relate to the design and structure of software developed for different purposes and to different paradigms, and to constraints upon the exploitation of intellectual property.

There are inherent differences between the requirements for internal use of software, and marketable, supportable, cost-effective, software product. There is almost a continuum extending from a client and purpose specific, locally supported solutions, to the opposite extreme of general-purpose, mass-market, easily implemented and minimally supported software products. Not all software product needs to be mass marketed and minimally supported and there are many examples of complex, higher cost, software products that require significant levels of support.

But such products also require sufficient flexibility in both their operational settings (operating system and hardware configurations) and client structures (location, management, fiscal, etc.). In the majority of cases, such flexibility is far easier to achieve if it is part of the design brief of the software development, rather than developed as a later addition in order to fit the development to the requirements of software product.

Where the client provides the design brief with detailed specifications, it is far less likely to incorporate product-level design flexibility, as this might result in a higher cost.

Developments structured in terms of the time and material employment of external developers, are even less likely to provide such opportunities in the design brief.

The significant reorientation in the provision of software and services to a more exclusive services relationship, epitomised by the growth of outsourcing, also mitigates against the likelihood of opportunities for product development in Australia, as, from our analysis, many of the major organisations now providing such services have much less history in the development of software products, or where they do have such experience, have tended to develop such products outside Australia.²⁵

When the design brief has sufficient flexibility for a software product to be developed, constraints on the intellectual property embedded in it makes software product development in many cases, non-commercial, or the development contract prevents further exploitation of the product.

Recognising that software products may be derived from the development at the design and contract point may enhance the opportunities for Australian firms to grow. It would also be advantageous if distinctions were made between confidential data, derived intellectual property ownership and IP exploitation rights within development contracts.

EU research and development projects that include both public and private sector participants can incorporate IP exploitation plans and agreements, developed either prior to the commencement of the research or during the research process.²⁶

In contrast, some governments and major commercial entities in Australia have, historically, reserved ownership of intellectual property within their software development contracts.²⁷

The *Commonwealth IT IP guidelines* (2001) were developed to encourage Commonwealth government departments to have regard to industry development opportunities and the capacity for governments to make savings by not acquiring all the IP. The guidelines are currently being reviewed to develop them as a practical resource for procurement officers to help them consider the full range of IP arrangements available to them.

The development of mechanisms for shared exploitation of intellectual property also includes the potential for shared usage by other agencies as well as the potential for commercial exploitation by the developers. This approach, and the consideration of product oriented design briefs as part of this process, would require significant changes to many current public and private ICT procurement processes, but could, in the opinion of the consultants, act as a major stimulus to software product development. The potential benefit to the Australian software industry of such changes would also depend, in the first instance, upon the domestic industry's market share of such projects.

Shared software development

There have been a number of initiatives in various markets in which groups of customers, often via industry bodies or other associations, have developed sets of common standards, shared requirements, or minimum paradigms for software products and services to address their needs.

These have then led to expressions of interest, or to the formation of ‘panels’ of approved suppliers. In some cases, such processes have led to the development of new software products, or, they have provided a marketing platform for successful applicants. In other cases the processes are still under development. Examples include:

- E-government—Municipal Association Victoria (federal Government funded) Local Government Online Services Project. Projects/products included online payments, GIS systems, e-procurement, and web enablement.
- Health—Australian Health Ministers Advisory Council (AHMAC) has sponsored the National Supply Chain Reform Task Force (NSCTF) since early 2003. This has focused on analysing the needs of the health supply chain, creating standards and encouraging pilots.
- Trade and commerce—Australian Retailers Association e-Commerce Committee is developing a functional template for point-of-sale (POS) vendors to create more conformity between the various POS systems.

Australia's software industry strengths

Australia’s main strengths in the development of software products are long-term experience in the field, compared to many other countries, and the quality of software personnel. As one focus group participant put it; ‘We write ... good software’. This is a generic strength, however, and needs to be directed to particular markets. Some of these markets, and our relative strengths and weaknesses in each of them, are explored in Part B of this report.

A number of other software industry strengths were identified during the focus groups, including:

- relatively low costs for software development (compared to US and Europe);
- strong Unix and open source skills;
- multicultural work-force and language skills;
- well educated and open society;
- well established and representative industry bodies;
- competitive and discerning domestic market;
- technological leadership in a number of vertical markets;
- technological leadership in some software niches; and
- higher quality finished software products than world norms.

There was, however, a strong feeling expressed during the focus groups by a number of software industry leaders that, in comparison to perceptions of the significance of the telecommunications and computer equipment industry sectors, and of international software product distributors, they felt that the relative quality, dynamism, and economic significance of Australian software development was under-appreciated and undervalued by other industries and by many in the various levels of government.

While the US is generally considered by those outside the software industry as pre-eminent in ICT, it was noted by some that the popular wisdom that the US invented the computer, the worldwide web, and software programming is false.

- First computer: Manchester, UK, 1948
- World-wide web: Theorised by Trevor Pearcey, Australia, 1949, developed by Tim Berners-Lee, UK
- Programming: popularly attributed to Charles Babbage and Ada Lovelace, UK, 1835

28

Other opinions on the US market included that the US has a very fragmented market with a myriad variations in taxes and local laws, a legacy of very old applications in key markets, arguably lower software productivity than Australia, and lower telecommunications infrastructure standards than Australia's. Nevertheless, the US has undoubted strengths in sales and marketing and many globally competitive companies.

Australia's software industry weaknesses

A number of significant weaknesses and barriers to growth, and areas upon which the software industry needs to focus, were also identified by the focus groups. These included the tendency for software producers to invest more heavily in presentation and marketing and innovation issues—the availability of investment capital, skills development, the disconnect between public research and industry. The presentation and marketing issue is discussed below and the other issues are discussed in the section on the innovation base, infrastructure and framework conditions.

Presentation and marketing

It is generally agreed that many Australian firms prefer to put their effort into producing better products, rather than presenting and marketing them. Some commentators felt that this was, in some cases, due to a lack of regard for profits—that some software developers are driven more by the wish to solve a problem than by a desire to have a profitable return. A number of measures were discussed that might help address this weakness. They included better business mentoring programs and the establishment of software marketing consortia or specific representation agencies.

Conclusions to software production analysis

Australia's software production capacity is contained within a large number of small firms, and a relatively small number of medium sized companies. Much of the market is dominated by a relatively small number of global suppliers, providing software products via subsidiaries or domestic distributors, but performing relatively little R&D in Australia themselves. Whilst the market is growing, it is currently structured more to services than to software products. However, this balance is shifting as outsourcing processes are reviewed and adjusted.

While software exports are almost certainly understated, the gap between the value of software product imports and exports is declining. The trade deficit in royalties and licence fees continues to grow.

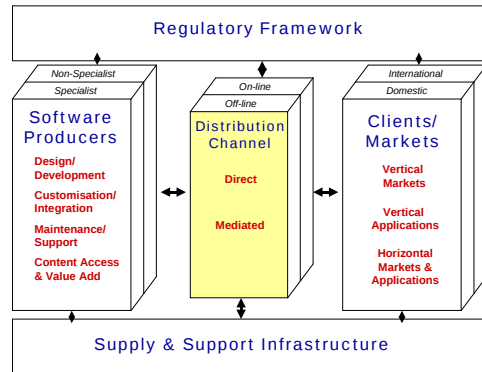
Australia's relative strengths in software production are not sustainable indefinitely, as other countries improve their software productivity and quality. We discuss issues that impact on the ability of Australian firms to be internationally competitive in the 'Innovation base' chapter, in particular capital and R&D links, and the availability of skilled labour.

Distribution of software

This section examines software distribution models and market entry techniques. It corresponds to the central box of the software product system map (i.e. the distribution channel).

Software distribution models

Software distribution can be defined in two ways: physical distribution models (i.e. how to get the physical product to the client); and financial distribution models (i.e. how to organise payment for the product).



Physical distribution channels

Table 4 lists the major physical distribution methods used, both domestically and for export markets, and some of the pros and cons for each. These have been derived from the focus groups and our consultations. Each method has its adherents, and each is pertinent to particular products and markets.

It was noted that, in some specialist markets, an existing user of the software product can become the distributor, or may be responsive to a joint-venture proposal. A further, usually short-term, process can involve a 'mate' system, where another Australian firm, whether in ICT or not, offers, the use of offices, staff contacts, etc. to assist on either low-cost, deferred, or long-term shared terms. A number of successful Australian ICT exporting firms in the focus groups indicated that, in the right circumstances, they may be responsive to approaches of this nature from other companies.

Forum participants also noted that there have been experiments in the past with software export consortia, export representative offices and other support mechanisms to provide an alternative to physical representation offices. These have included the Austrade supported European Software Export Centre, the Paxus US software centre, and two Victorian Government supported software consortia (CPX and ITC). All arrangements involve risks and the outcomes of the initiatives were variable. Some resulted in enhanced marketing for Australian firms, some eventuated in mergers. The tech-wreck related collapse of market funding had adverse consequences on some of these initiatives, as did the uncertain continuation of government funding.

Table 4 **Physical distribution models: pros and cons**

Method	Pro	Con
Online Download	Minimal cost No middleman	Piracy problems Difficult for providing support
Branch Office	High control Direct customer contact	Most expensive
Sole Distributor	Needed in some markets Useful as a mechanism for providing local market knowledge	Training costs, Potential revenue loss, Difficult to provide service quality control
Shared distributor	Needed in some markets Useful as a mechanism for providing local market knowledge May have broader coverage	Competing with other suppliers, Less visibility
Wholesaler	Good for shrink-wrap products, May be only route to retail market	Worst for revenue, visibility and marketing
Publisher	Good for shrink-wrap products, May be only route to retail market	
Bundled product with manufacturer	Strong channel to market	May restrict product to one manufacturer, Difficult for contract enforcement
Badged product with manufacturer	Strong channel, Guaranteed return (royalty only)	No visibility for software developer, Dependant on others

Source: CIIER Analysis.

Financial distribution channels

Traditionally, financial distribution models have split between the ‘single sale’, e.g. outright sale or one time licence fee, and ‘multiple sale’, e.g. various combinations of periodic fee involving licences and/or maintenance/upgrades. These distinctions have generally been based upon the preferred model for the company, rather than being segmented on the type of product. Multiple fee systems have normally required a higher level of capitalisation for the companies concerned, in order to balance delayed cash-flows with expenditure.

Several US analysts have recently commented on the strong growth in the emerging Software as a Service (SaaS) market.²⁹ SaaS is the process of providing software products as a download or process at runtime (i.e. at the time that the software product is required to be used) on a fee-for-service basis for each usage. IDC recently suggested that worldwide spending on software as a service (SaaS) reached \$4.2 billion in 2004, an increase of 39% over 2003. This reinforces the results of a survey conducted by US based Saugatuck Research earlier in 2005, which found that North American Chief Information Officers (CIOs) plan to

use up to 14% of new IT infrastructure spending on ‘pay as you go’ IT services, and 13.8% of new IT application spending on software as a service in 2005.

Table 5 Financial distribution models: pros and cons

Method	Pro	Con
Outright IP sale	Upfront revenue	No further revenue Potential loss of access to future IP development
Territory sale (right to IP in geographical region)	Upfront revenue	Often hard to sell Can easily underestimate potential market
One time licence fee (OTLF)	Industry standard	Ongoing service cost long after revenue
OTLF + annual service fee	Industry standard	Sometimes hard to maintain service fee revenue Administration overhead
Annual fee for service	Industry standard	Effectively a resell each year Amortisation of initial costs needs careful consideration
Run time licence fee	Ongoing lag revenue	Ongoing service expectation/cost
Seat based licence (based on the number of users)	Variable pricing to suit market	Complex to administer and police
Web -enabled/usage (SaaS)	Attractive to users, emerging model	High capital cost to set-up May involve security issues
Shareware donation	Very user-friendly	Limited suitability May be difficult to make a profit Unattractive to investors

Source: CIIER Analysis.

A number of attendees at the consultation forums indicated that the incidence of more complex market models, and, in particular, the use of various service based deliverables, such as the SaaS approach, were part of their forward planning or were already in place for particular products.

One respondent, in particular, indicated that their very major US sales position could only have been achieved through this model. However, a note of caution was also sounded by software industry specialists, as SaaS is not suitable for all products and markets. The consensus was that, while SaaS has definite attractions, as with application service providers (ASP) and other market models in the past, the enthusiasm of the industry watchers does not always translate into commercial reality.

Selecting physical and financial models

The choice of a particular physical or financial model for either the domestic or selected international markets is neither a trivial nor simple exercise. Some markets may require direct representation, others may benefit from a distributor with local knowledge, some may be sophisticated enough for electronic delivery methods, depending upon various indicators, including market size, competition, client expectations, the complexity of the software product, the relationship between the software product and associated services, and cultural and business mores.

Decreasing costs associated with electronic distribution and 'fee-for-usage' financial models such as SaaS, is expanding the range of options available to smaller firms to develop their international client base, and may be shifting the balance from products to services. For many smaller companies, especially, the same considerations may apply to the selection of appropriate models for interstate operations in Australia.

Market entry techniques

The following table outlines a range of market entry techniques with positive and negative comments on each derived from industry participants in focus groups.

Table 6. Market entry techniques

<i>Entry technique</i>	<i>Positive comments</i>	<i>Negative comments</i>
Country Visit	Almost essential	Rarely do business first time
IT Trade Show	Gives 'flavour' of IT in the market.	Expensive If you exhibit you will get stuck on a stand and see very little of the competition or the market
IT Trade delegation	High level contacts, high visibility	Can involve significant participation in time-consuming 'social' events for local dignitaries
Vertical market trade show	Best way to assess market potential	Need to get invited
Advertising for a distributor	Could get lucky	Creates vulnerability
Local IT trade Association	Very helpful in some markets	Need to make commitment to the local industry
IT Conference	Contacts can be good Getting speaker status is very useful	Often held at expensive hotels Involves mandatory social scene
Austrade local office	'On our side' Has local market knowledge	Some far better than others Involves some fees - often costs unrelated to value
State govt offices in markets	As Austrade, but some even offer a loan desk	Few and far between
Export advisory services/consultants	Can save you a lot of time and money if they know their stuff	Variable quality Some know export market but do not understand software

Source: CIIER Analysis.

We did not rank these market entry techniques, as they vary in significance considerably for both products and markets. In general, however, it was felt that the more government influence applies to a market, the more useful techniques like IT trade delegations become.

Free trade agreements

Free trade agreements (FTAs) can assist in reducing barriers to trade between nations, but their impact can vary depending upon the terms of the agreement and the market status of the two nations.³⁰ In the case of software products in particular, an FTA can be of most value to the Australian producer where the target country market is growing quickly and there are fewer dominant suppliers. This category would include: Thailand, Malaysia, and parts of Peoples Republic of China (PRC), and the Baltic States.

An FTA may open fewer opportunities in countries/regions with mature commercial markets, such as the US and UK where there are significant and established suppliers. However, the private sector markets in such countries have generally presented few non-commercial barriers to entry for good software products.

Significant barriers to access to the government purchasing market may remain, regardless of FTAs. For example, Australian SMEs cannot access the SME set-aside portions within US federal government contracts. Access to the other parts of the US government market, can be difficult for all small firms, regardless of the country of origin.

Few small tech outfits ever get close enough to the Pentagon to talk to someone about their technology. For all the buzz about private industry cashing in on spending by the Defence Department and federal intelligence agencies, the little guys hardly ever land those contracts. Indeed, it's usually tech giants like IBM, Perot Systems, or the half-dozen or so Washington-centric consulting firms that industry insiders like to call the 'Beltway Bandits'.³¹

Success and failure

A study by Software Engineering Australia also identified a series of generic business success factors derived from other industries, and mapped these against the Australian software industry.³² SEA concluded that the Australian software industry is under-developed, but that many of the requirements and precursors are already in place.

Box 2. The nature of success factors

Intrinsic attributes of the industry: Some industries in Australia seem inherently suitable to become vibrant and successful by virtue of geography, climate, space, character and aptitude of people, language, etc. There is little that can be done about altering these intrinsic attributes, but it is important to recognise whether they exist or are absent.

Actions that foster and sustain: Even if the intrinsic attributes exist, it is necessary for specific, identifiable actions to be taken by some individuals or organisations for the industry to prosper.

Attributes of the resulting ecosystem: Other success factors are observable features of mature, successful industry ecosystems. Their development and proper functioning seem to be prerequisite to success.

Source: SEA. CIIER Analysis.

Focus group participants identified a number of success and failure factors for software exports. They include:

Success

Understanding the market
 ‘Wanting it enough’: the desire to succeed
 Necessary funding: ‘it always costs more’
 Having the right product at the right time
 Competitive pricing: ‘cheap is not the best’
 Good trustworthy staff
 Competitive intelligence: ‘knowing the enemy’
 Contractual protection
 Competent technical support network and
 ‘Getting close to your customers’.

Failure

Committing cultural faux pas
 Failing to understand commercial operating practice differences
 Overselling our ability to deliver
 Them overselling their ability to deliver
 Not allowing enough negotiation time
 Being too direct and forthright (e.g. talking like an Australian)
 Poor language skills leading to misunderstanding (e.g. assuming that people speak English)
 Underestimating travel and accommodation costs
 Not having the ‘elevator pitch’ tuned and ready
 Underestimating service time and cost
 Being too greedy, or too generous
 Trusting too much, or too little
 Not allowing for currency variations
 Not allowing for freight costs and delays
 Not allowing for government regulations, taxes, and charges
 Forgetting that ‘it’s their country—it’s their legal system’
 Making it difficult to get yourself out of a bad contract
 Making it too easy for them to get out of a good one
 Failing to protect IP

These success and failure factors presume that the company concerned has already put into place its capital requirements, has established its track record, reference sites, and credentials, has created appropriate relationships with platform vendors and other stakeholders, has developed effective marketing material, and has a sustainable revenue stream to allow it to meet its operational outgoings.

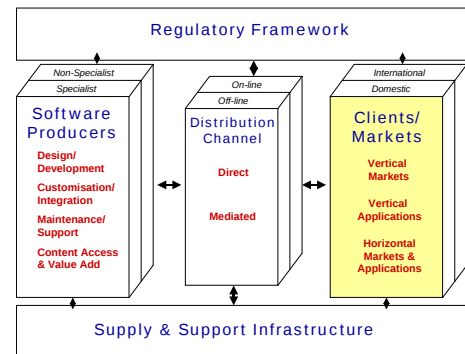
Conclusions on software distribution

There are a multitude of different physical and financial distribution models for software products. The choice of the appropriate model will vary for companies, products, and markets. The growth of the internet has opened up new opportunities for lower cost distribution models that may assist some producers.

Market entry models also vary considerably, and the choice of the appropriate mix is not an easy one for companies to make. Recent developments in free trade agreements may assist in some countries, but success or failure in markets has more to do with market intelligence and understanding by the company concerned, than any external factor.

Software markets

This section examines software market dynamics, domestic and international markets for software. This section corresponds with the right-hand box of The software product system map (i.e. clients and markets). The approach here is generic, with issues relating to specific vertical market applications dealt with in the second part of the report.



Market dynamics

One of the interesting aspects of vertical software markets is their volatility and variability, and how these are impacted by technological change. *Changes in technology can help to create new or enhance existing vertical software markets.* In the games software market, for example, significant technology breakthroughs in graphics, processing power and storage created low cost platforms capable of supporting multiple complex games systems and engendered the mass-market for games software. *But just as technology can create markets, it can also constrain them.*

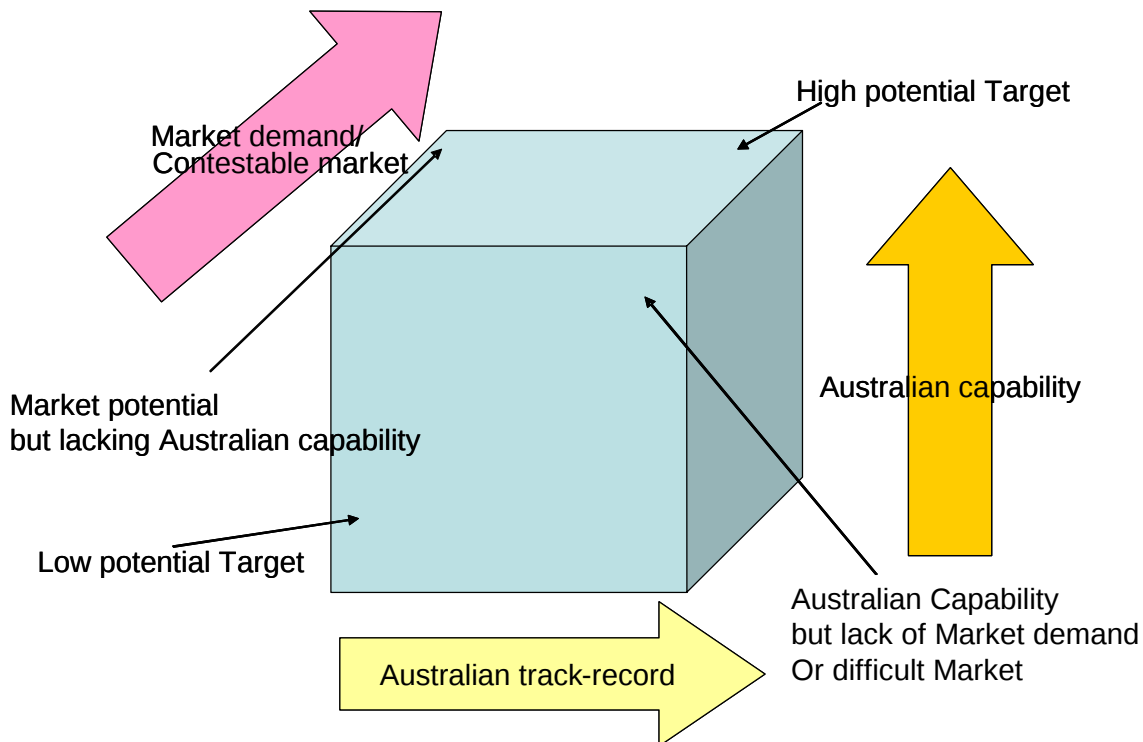
In the same games software market, for example, the key platform suppliers are now engaged in a struggle for market share and, as one of their weapons in this, are using the constriction of what were previously more open software platforms, so that only developers within the platform supplier's specific sphere of influence can produce saleable products for that platform.

These examples show how client demand together with advances in technology can create or enhance software markets. Software producers respond to this demand by producing software products, but controllers of distribution channels can use technological change to constrain or control those markets.

In a number of vertical software markets a key problem for Australian firms is establishing or maintaining its distribution. Firms that directly distribute (e.g. Mincom, IBA, Computershare, etc.) tend to have strong position in a niche market, a direct interface with leading edge clients in a specialist environment, and little exposure to mass market retail distribution of their products. The health, energy and minerals verticals tended to have more firms of this nature.

Another aspect to selecting appropriate software markets to focus on is that a globally expanding and contestable market is insufficient if one cannot demonstrate Australian track record and capability in that market. The ICT vertical is one in which we have both established track record and excellent linkages to global players, and we have an emerging track record in trade and commerce, and some established strengths in manufacturing.

Figure 17. Three dimensions of software markets



Source: CIIER Analysis.

Conversely, it is often not enough to have excellent Australian capabilities or track record in a software market, if the global market is too thin or too difficult to contest. The government market is one in which the domestic market may be more significant than export markets, but Australia's relatively strong position in e-government implementation means that Australian companies are often positioned at the leading edge of this market.

Education is another market in which our comparatively strong domestic stage of usage creates a potential export platform. As illustrated in the figure above, the optimum position is in markets that exhibit all three dimensions (or at least two of the three with the potential for the third).

Access to Australian markets

A key issue for smaller software producers is access to markets. Singleton (2003) noted:

If our software firms are to prosper and grow exports, they need to be in partnership with key clients, integrators and services firms— potential prime solutions contractors, as well as associated specialist hardware suppliers and international operators. Australia, however, currently lacks services firms and prime contractor integrators that are not tied to foreign supplier alliances.³³

Governments are a major purchaser of ICT goods and services. For the Australian Government, while value for money is the core principle underpinning its procurement, the

Commonwealth Procurement Guidelines require government agency purchasing officers to ensure that local industry is able to compete for government business. The government is also working to improve the commercialisation of IP from government ICT contracts and to achieve appropriate capping of suppliers' liability in contracts. Some governments and major commercial entities in Australia reserve ownership of intellectual property within their software development contracts³⁴ and consequently there is limited opportunity for Australian firms to exploit this IP in projects with other customers. The desirability has also been recognised of agencies taking opportunities to collaborate on ICT procurement both by leveraging government's collective buying power and by reusing IP across government.³⁵

The 'small and insignificant player' issue

It may be that Australia's market is too small to develop and sustain significant firms in the ICT industry. However, Australia's market significance would tend to disprove this.

- Australia has the twelfth largest economy in the world.
- Australia together with New Zealand has a larger GDP than all of South East Asia combined.
- Australia has the ninth largest ICT market in the world.
- Australia has the second largest ICT market in the Asia-Pacific, although China is swiftly growing and will push Australia back to third position in coming years.

Table 7 Sample of countries with smaller domestic ICT markets

<i>Country</i>	<i>Firm</i>	<i>Relative % to Australian Market</i>
Finland	Nokia	22.10%
Sweden	Ericsson	57.17%
Norway	NorskData	26.79%
Korea	Samsung	83.18%
Taiwan	Acer	35.74%

Source: WITSA.

The suggestion may also overestimate the domestic market size required to establish world scale ICT firms. Whilst each case is unique, and other factors come into play, the countries listed in the table accompanying have smaller domestic markets than Australia, but each has at least one globally competitive ICT firm.³⁶

Other countries, such as Israel and Canada, have significant domestically owned ICT firms, despite significant presence of international MNCs. We consider that Australia has a large enough domestic market for firms to establish and expand, if there are sufficient firms capable of doing so and if they can have fair and reasonable access to that market. There are many examples of successful ICT related firms, (e.g. Computershare) that would support this contention.

The Role of multinational corporations in the Australian market

In the ICT industry, some MNCs, such as Mincom, IBA, and Telstra, are Australian, although most of the MNCs operating in Australia are foreign-owned. Some of these Australian-owned companies are identified and commented upon in this report, particularly in the discussion of the vertical markets.

Creating, building and sustaining these MNCs could be the most important element of any strategy to develop Australia's software industry. However, most discussion on the role of MNCs in Australian industry development focuses on those headquartered outside Australia. In this report we consider foreign MNCs primarily from the viewpoint of their impact upon the Australian software market, and on Australian software suppliers.

Governments maintain non-discriminatory purchasing and business policies, and actively encourage overseas owned companies to establish and maintain operations in Australia. A number of overseas owned ICT companies have extensive operations in Australia, and, in some cases, a history of significant investment and research in Australia.

It is important to understand, however, that, in terms of economic benefit to Australia, attracting an overseas owned company to establish facilities in Australia, while simultaneously losing a similar Australian owned company, is not a simple equivalent.

Attracting ICT MNCs to locate in Australia can increase employment, and often creates investment. It is CIIER's view that the retention of such companies, however, is less certain than in, for example, manufacturing as the infrastructural investment in plant and equipment for software companies is low and financial constraints on relocation are therefore minimal.

Growing and, just as importantly, retaining, domestic ICT companies, can increase exports, reduce the trade deficit in ICT goods and services, and enhance the accumulation of capital and ICT technical and management skills in Australia.

However, overseas owned ICT MNCs do not act in a homogenous way and MNC behaviour can range from an active, participative engagement with the Australian economy through to a short-term focus, aimed purely at selling overseas products and services in the Australian market. This variation in behaviour was commented upon in Thorburn *et al.* (2002):

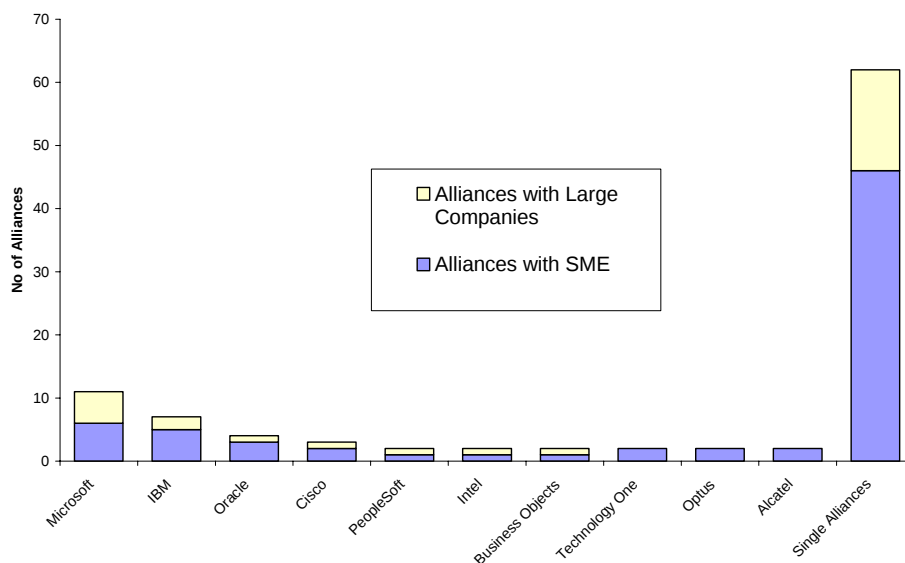
There were some significant differences between firms by nationality, management type and mode of entry. These variations show that it is dangerous to take a 'one size fits all' approach to promoting inward investment. As a group, US respondents were larger, but were less likely to have RHQ structures that gave the local subsidiary autonomy. They were also less likely than UK/European respondents to export and to undertake R&D. Overall it appeared that UK/Europe respondents were more outward looking and their subsidiaries had a greater contribution to make to global operations.

There are also significant differences between MNCs according to their contribution to the regional or global product development of their firm as a whole. Employment was highest in firms that had only a local mandate, but these firms were unlikely to be RHQs and also had less autonomy. MNCs that had a regional or global mandate were much more likely to export, work with customers, transfer technology to customers and be in control of product development than local mandate firms. Thus, they are likely to have a greater positive impact on the economy as a whole.³⁷

While all companies have a responsibility to create and sustain profit for their shareholders, individual MNCs perceive strategic value in heightened levels of engagement with local industry and with the local economy. Some overseas owned MNCs have active and supportive relationships with local companies through clusters and networks, some work closely with Australian industry and some with Australian research bodies. Many of these activities are of direct benefit to the Australian ICT companies, many of which are software companies, with which the overseas owned MNCs relate.

In the December 2004 T250 survey, 73 MNCs, mostly overseas owned, were identified, with 99 nominated business alliances between them, of which a significant number were with Australian ICT SMEs.³⁸ These relationships can, at their best, encourage research synergy, and assist with both domestic and export marketing, and with the management skills of local companies. But such strategic engagement is always predicated upon the benefit for the MNCs concerned, or it could not be encouraged or sustained, and the key benefit that is normally required is enhanced market access and increased market share for the MNCs.

Figure 18. ICT MNCs in alliances with Australian SMEs, December 2004



Source: Whitehorse Strategic Group.

From the perspective of the development of the Australian software industry, we argue that the Australian ICT industry benefits directly where the net economic benefit of MNC investment and employment in, and strategic support for, the software industry exceeds the value of the imported products. (This does not take into account direct impacts in the wider economy such as productivity gains from the use of overseas-developed software and services.)

There are also indirect benefits from the presence of MNCs including skills upgrading, access to technology, domestic research, and overseas market access. Other indirect benefits may

include increased productivity and innovation in domestic firms in the same industry and supply linkages between MNCs and domestic firms, leading to increased employment and higher wages.

A report by the Prime Minister's Science, Engineering and Innovation Council in 2000, derived from an analysis of individual corporate data from the Partnerships for Development (PfD) Program, the R&D Scoreboard, the *Business Review Weekly's* Top 500 List and the Fortune Global 500 List, noted:

There is a noticeable difference between the R&D performance in Australia of a select group of foreign owned corporations and their global R&D. Although not exhaustive it illustrates that most MNCs perform much less R&D in Australia than their world average.

The report went on to say:

The dominance of the MNCs in the ICT industry and their relatively weak R&D performance is a major contributing factor to Australia's overall ICT business R&D (BERD) underperformance. If this group of MNCs had an ICT R&D performance in Australia equal to their world averages, then an additional \$1 billion would be spent annually on ICT R&D in Australia, raising total business R&D expenditure to \$4.9 billion or around 0.8% of GDP.³⁹

Whitehorse analysis suggests that, with some exceptions, there is a discernible difference between the MNC attitudes to Australian R&D from US headquartered companies, compared to those headquartered in Europe and in Asia.

Historically, much of the European owned ICT R&D was focused on telecommunications and engineering, and this has now declined from its former strength, although companies like Alcatel and ADI continue this tradition.

Companies such as NEC, Fujitsu, Toshiba, and Canon have been joined by companies such as Infosys in a growing Asian corporate research base in Australia. Whilst much of this research may be aimed at equipment outcomes, a significant proportion has a software focus.

Box 3 Canon Information Systems Research Australia

Established in 1990, and owned 51% by Canon Inc. and 49% by Canon Australia, CISRA (Canon Information Systems Research Australia) is the Australian R&D centre for Canon Inc, the world's leading provider of cameras, business machines and imaging and information technologies. CISRA has grown from a small R&D group to one of Canon's largest R&D centres outside Japan, with over 250 engineering and support staff and annual revenue of AUD 40m. Together with Canon R&D centres in Japan, America, Europe and Asia, CISRA is a key part of Canon's future product development.

Despite the significant and integral role played by MNCs, domestically sustainable industries normally include a significant measure of technical and managerial sovereignty. That is, they are capable of controlling their own destiny, both in terms of decisions to invest, conduct

research, employ and develop, and in terms of the technical and financial capacity to implement such decisions, within the context of a global industry.

‘Branch office syndrome’ is a phenomenon common to every industry, in which cutbacks tend to take place as far from head office as possible, and most important and strategic investments are kept close to home.

There are significant benefits to MNC presence in Australia and we consider it important that major MNCs be encouraged to headquarter regional and global operations here, to avoid insularity of the Australian industry and to ensure that Australian firms have access to technology and exposure to market.

However, to sustain a domestic software industry sector, CIIER considers that a significant proportion of software research, development and market share needs to be under Australian control, and in order to sustain a vertical software product development capacity, the industry needs to maintain an innovation base that will encourage and nurture firms as they grow, and that will reduce relocations, selling off or losing Australian IP.

Overseas market selection

There is a tendency to assume that the largest market is always the best, but chasing the largest potential market can be poor strategy. Selecting the best overall potential market for a particular vertical software product can be a more complex process.⁴⁰

The considerations, other than pure market size, include the cultural and political background of the target country and its ‘fit’ to Australia (e.g. trade relationships, language differences, proximity to Australia/cost of travel, economic structure and legal system, and demographic relationship to Australia (e.g. migrants, expatriates, students, etc.). These considerations are often expressed in the form of indices, which, when combined with a potential market size index, can assist in the selection of appropriate target markets.

The methodology for the market analysis was developed and refined from a number of similar studies of a more generic nature, and was tailored to reflect the specific factor mix and weightings that are important for ICT.

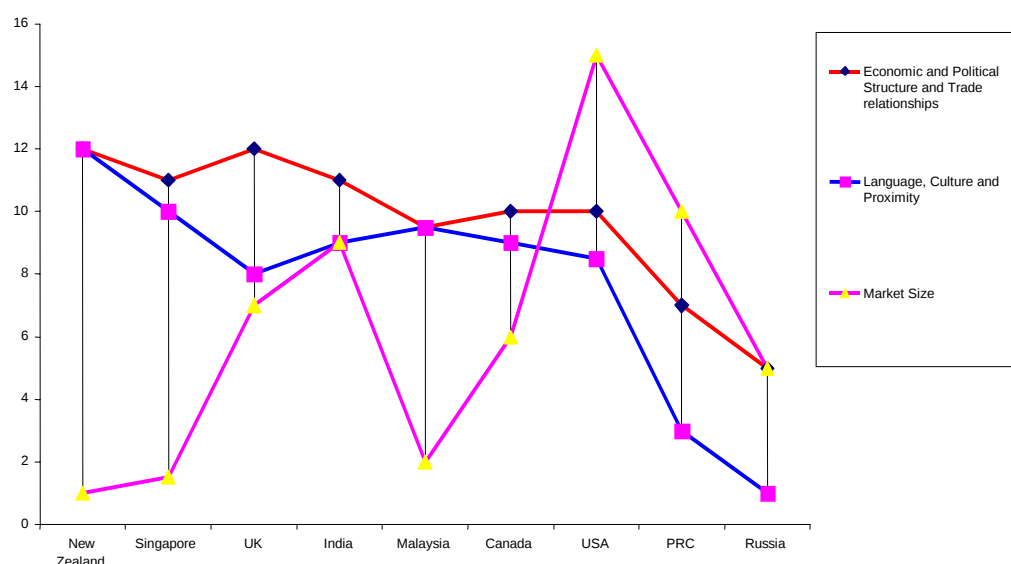
The approach was to identify the specific factors that relate to the ICT investment decision, to source independent and reputable location based assessments of these factors, to apply a consistent ranking technique to each of the factors, and then to group them into the three basic considerations, of people, environment, and cost.

Weighting was then applied to each factor and the individual and combined rankings analysed by location, so that preferred locations could be selected. A large number of investment factor sources were identified and evaluated.

In most cases data was used from reputable international bodies, in particular those with a specific focus on the factor concerned, e.g. productivity bodies for productivity data, accounting bodies for accounting data. Two or more sources were identified for every factor in order to minimise bias, the most up-to-date information in each case was utilised. Whilst the detailed methodology is proprietary, the data sources included the Australian Bureau of Statistics; Business Software Alliance IPR Global Software Piracy Study; Harvard University Business Competitiveness Index; IDC; IMD World Competitiveness Yearbook 2003; International Monetary Fund; International Software Benchmarking Standards Group Ltd;

A.T. Kearney; Nexia International Accounting Group; OECD; Political & Economic Risk Consultancy Ltd; Richard Ellis; Standard & Poors; World Information Technology and Services Alliance.

Figure 19. Market selection indices for selected countries



Source: CIIER Analysis.

The accompanying chart shows a generic summary of such analysis, in which the market size index shown is derived from the size of the general ICT market, as calculated by WITSA. Whilst 'radar' and other chart forms can provide more understanding of particular factors, this form of chart helps to identify the relative significance of the different indicators, shown by the range between the indices for any particular country.

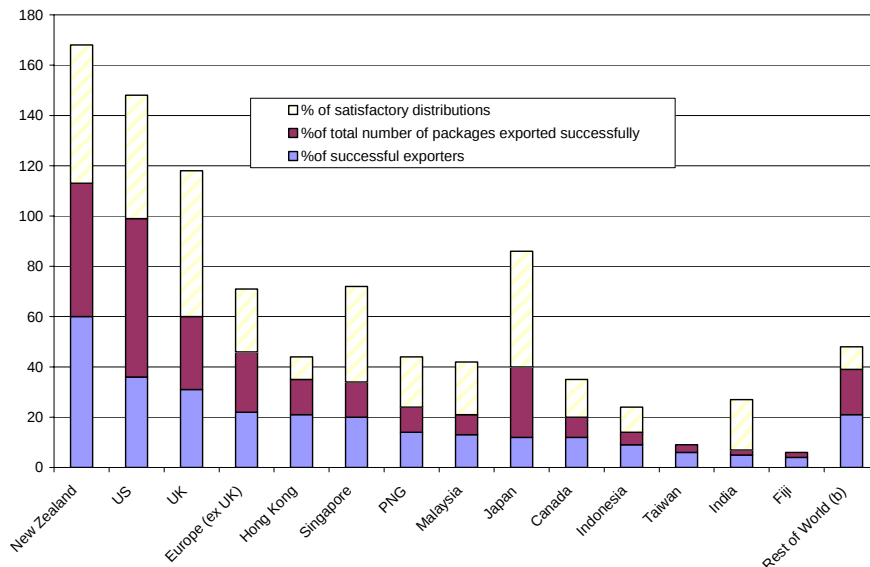
Ideally, a market should have a relatively high market size index, and a small range between that and the two other indices, which suggest 'ease' of market entry, and the cultural and organisational operational "fit" to Australian practice.

On this basis, the easiest market for Australians on cultural, political, demographic and economic indices is New Zealand, but New Zealand also scores a low index for the size of its market.

The next most 'logical' market, out of this group of indices, is Singapore, followed by UK, India, Malaysia and Canada.

On the 'size of market' index alone, the US is by far the market of choice, but for a number of software producers, providing the market size was not too small for their particular product, it might be a more sensible approach to develop their export skills in easier markets first, providing the market in such countries can provide a viable return.

Figure 20. BIE software export market evaluation, 1989



Source: Bureau of Industrial Economics, 1989, "Selling Packaged Software Overseas", Chart reconstructed by CIIER

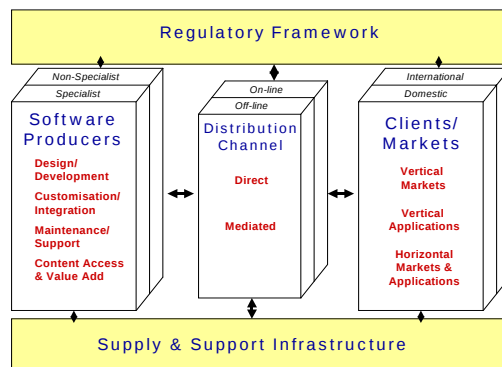
The Bureau of Industry Economics ranked software export markets in 1989, considering both the then successful overseas markets for software and the most satisfactory distribution arrangements. It indicated that almost twenty years ago countries like New Zealand, UK and Singapore were strongly favoured.⁴¹ This suggests that many of the selection factors are enduring, with changes relating either to variations in growth in particular markets or to market entry difficulties or improvements due to other factors.

Conclusion to software markets

Australia's software markets are both dynamic and volatile, and despite its small size, the domestic market is well able to provide the underpinning support for globally successful Australian companies. Improved access to this domestic market for Australian producers is very important however to sustain operations and growth, and, whilst a number of MNCs are supportive of the Australian software industry, others are mainly concerned with their own market share. The selection of the right countries to target for export markets is a complex issue for many companies, and can be crucial to success.

Innovation base, infrastructure & framework conditions

The innovation base for the software industry includes domestic infrastructure, the public sector R&D base, the skills base and the domestic market. Coverage in this section corresponds with the ‘collective support infrastructure’ and ‘regulatory framework’ (i.e. upper and lower boxes of The Software Product System Map outlined above).



Domestic framework and infrastructure

The primary infrastructural elements of innovation for the software industry sector are access to capital, communications capability and a supportive taxation and business environment (e.g. intellectual property protection). The following discussion provides a limited statistical analysis relating to the issues, where the data is available. However, the issues are complex and some of the key concerns identified in the focus groups, or in other sources are presented.

Access to capital

While still small relative to other OECD countries, Australia's venture capital market has been growing. As at June 2004, investors had \$9 billion committed with venture capital investment vehicles, compared with \$5 billion in 2000. Of the \$3.1 billion that had been invested in the 909 investee companies at June 2004, \$465 million was invested in new projects during the 2003-04 financial year. As at June 2004, \$697 million (23%) was invested in 333 IT, media, electronics and communications firms.⁴² Nevertheless, there is currently a reported dearth of capital for start-ups.⁴³

A number of studies of the ICT industry in Australia have concluded that the availability of appropriate investment, and especially second-tier, patient capital, is its most significant weakness. While a series of initiatives and programs address the issue, the weakness continues.

The current Australian Information Industry Association (AIIA) submission (June 2005) to the government enquiry into the venture capital industry states:

A common view within the local ICT industry is that there is a low level of availability of venture capital and later stage private equity funds.

On the other hand, the venture capital sector and business angel networks believe that capital availability is not the problem; rather it is one of quality deals being available.

The Australian venture capital market is immature when compared to the sophisticated market in the US and one of the implications of this is that smaller ICT companies often struggle to understand how to best engage potential investors and access the critical pre-revenue funds necessary to fund growth.⁴⁴

This suggests that many of the concerns that industry participants have expressed for some years remain and may well be a systemic aspect of technology investment in Australia.

Communications capability

Communications capability, especially high levels of broadband bandwidth and reliability, is very important to software developers, just as it is to many other industries. While communications capability is generally at an adequate standard in most capital cities, the development of software companies in regional Australia can be adversely affected by either inadequate or expensive communications capability.

Focus group attendees have commented that the relatively low level of adoption of high capacity broadband in Australia, including by many local SMEs, also adversely affects local software industry development, as it diminishes their capacity to provide sophisticated internet based products, and to use internet based distribution methods, for those clients without such capacities.

Taxation and business environment

Taxation and other operational issues that impact upon the software industry are the same as those affecting almost every other industry. Operational issues tend to relate to regulatory compliance requirements (e.g. compliance cost increases from introduction of the GST, impending compliance cost increases from superannuation changes), while taxation issues tend to fall into two categories, GST cash-flow implications and the tax implications of R&D expenditure. Focus group respondents commented that some changes to the R&D tax concession had made it less attractive to invest in R&D.

Intellectual property protection

Australia has sound intellectual property protection for computer software.⁴⁵ Indeed, Australia can claim to have led the world in the adoption of specific intellectual property protection for software, including the first definition of software for the purposes of copyright protection, patenting of business methods, and the first criminal sanctions for abuse of software copyright.

This creates a protected environment for software developers, and it is recognised by many international companies as a supporting factor for software development investment. It also creates a situation in which Australia is an attractive market for international software developers to test their new products with a relatively strong sense of security.

Australia's relatively strong position on intellectual property protection for computer software has gradually been translated into an improved position in many other parts of the world, and in particular in South East Asia. Australian representatives within the Asian-Oceanian Computing Industry Organization (ASOCIO)⁴⁶ have strongly argued that intellectual property protection is a precursor to successful development of a local industry. This has been recognised by many of the industry representatives from other countries. International agreements and forums, in particular the World Intellectual Property Organization and the World Trade Organization (through the Trade Related Aspects of Intellectual Property Rights Agreement) have also encouraged many countries to improve software protection. Australia is

also in the process of negotiating a number of FTA's with South East Asian Countries. There has been a gradual improvement in legislative frameworks in other countries, including in South East Asia. As the legislative frameworks improve and compliance increases, export markets have become more attractive for Australian software developers.

Some focus group attendees were concerned that the 'harmonisation' provisions embedded within the recently signed Australia-US free trade agreement (AUS-FTA) may have the impact of varying Australia's strong software copyright protection in ways that are a negative for the industry, by requiring Australia to alter its legislation to more closely correlate to that of the US. Other industry sources, however, hold the view that such variations, if required, may act to strengthen Australia's software copyright protection. Concern has also been expressed that some of the potential benefits inherent in an FTA with China may be difficult for Australian software producers to achieve, until intellectual property compliance in that market is stronger.⁴⁷

Other regulatory issues

There are a range of other regulatory issues affecting software firms, as they do firms in other industries. These include:

- privacy legislation and the need to build compliance mechanisms into development;
- professional indemnity and liability, an area in which recent developments have adversely affected SMEs in many industries;
- technical and professional accreditation, including a range of compliance and accreditation issues; and
- technical and quality standards.

Whilst the scope of this report is insufficient to comment on all of these, standards is an area in which Australian ICT research groups, firms and government agencies have cooperated effectively. Standards Australia has focused on understanding industry needs and delivering services to meet these needs through: rationalising standards; improving communication; managing interfaces; promoting international competitiveness; encouraging innovation; enabling interconnectivity; and reducing competing proprietary standards.

This effort has been supported by many industry players, with overview provided through the Communications IT and e-Commerce (CITEC) board. Current areas of standardisation within IT and e-commerce fields include: health informatics; software and systems engineering; e-learning; geographical information; intelligent transport information systems; records management systems; interactive voice response systems; ICT governance and management; e-business architecture and data exchange; biometrics; security and identification technology; computer modelling and simulation; multimedia; data management and interchange; automatic identification and data capture techniques; financial transaction systems, communications cabling; broadcasting and related services; telecommunications; and electrotechnical.⁴⁸ There is also active engagement in international standards forums by many of the ICT industry and professional groups.

The Australian Government established a software quality working party in June 2004 to examine the importance of software quality accreditation to the development of the Australian

software sector. The report was released on 18 February 2005 for public comment but the implementation plan was not available at the time of this research

Software Engineering Australia and others have strongly supported the drive to encourage more Australian firms to adopt and apply relevant quality standards certification. AIIA have now taken up the SEA initiative, and are offering support to this process, as is the Victorian Government. Nevertheless, there is scope for Australian software firms to pay greater attention to quality accreditation and standards in order to enhance their capability to address export markets, and there is concern that too few firms adopt achieve certification, and perhaps even fewer achieve heightened software quality.

As mentioned above the Australian and other governments, in particular the Victorian government, are working to achieve appropriate capping of suppliers' liability in contracts. The Australian Government released in November 2005 a draft guide on limiting supplier liability in ICT contracts.

The ICT research base

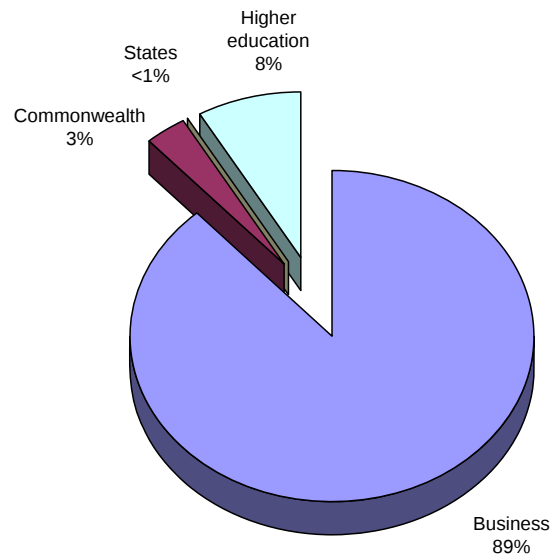
The sections that follow explore ICT related R&D activities, first by socio-economic objective and then by field of research (research fields, disciplines and course). The former tells us about innovations likely to feed into the ICT producing industries, applications and solutions, while the latter tells us about information and communication sciences.⁴⁹

ICT R&D as a socio-economic objective

The Australian ICT Industry Update 2003⁵⁰ report showed that a total of \$1.55 billion was spent on R&D in information and communication services *as a socio-economic objective* (SEO) in 2000–01: 15% of all R&D expenditure by socio-economic objective. Some 10 138 person years were devoted to information and communication services R&D activities in 2000–01, more than 10% of all human resources devoted to R&D in that year.

(As expenditure data includes the cost of equipment and services, person data can give a better indication of the true amount of research effort undertaken). The vast majority of the expenditure on information and communication services R&D took place in businesses (88%), less than 8% took place in higher education institutions and less than 3% in Australian Government agencies.⁵¹

Figure 21. Share of R&D expenditure on information & communication services (SEO), 2000-01 (%)

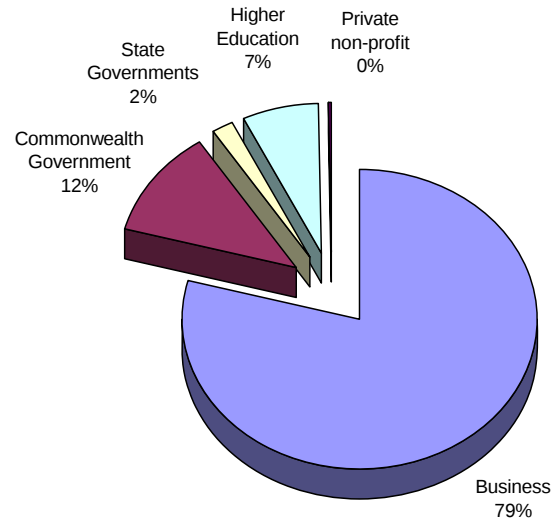


Source: CSES analysis.

ICT sciences R&D as a field of research

The Australian ICT Industry Update 2003⁵² reported that, in 2000–01, \$1.6 billion was spent on information, computer and communication sciences R&D *as a field of research* (FOR) economy-wide; 5.5% of total R&D expenditure in Australia by field of research. (Note: communications technology is not included.) Business expenditure (all industries) in the same period amounted to \$1.26 billion or almost 80% of total ICT related R&D expenditure, Australian Government institutions accounted for \$197 million or 12%, and the higher education sector for \$113 million or 7%.⁵³

Figure 22. Share of R&D expenditure on ICT sciences (FOR), 2000-01



Source: CSES analysis.

A DEST report in 2003⁵⁴ suggested that Australia is unusual in the high proportion (29%) of its total research effort that is conducted by firms with fewer than 100 employees. It stated that this proportion is higher than for any other OECD country apart from Iceland, and that SME research in Australia is highly concentrated in computer software (62% of total ICT R&D expenditure in 1998–99), and this may be because it is relatively low cost.

Analysis by DCITA⁵⁵ reveals that the Australian ICT industry's expenditure on ICT R&D (including communications technology) was \$1.4 billion in 2002-03, 64% of total Australian expenditure (\$2.15 billion) on ICT R&D. A DCITA report, '*An overview of the Australian ICT industry and innovation base*'⁵⁶ found that 'R&D expenditures by the ICT industry were highest on software and communications technologies, (about \$480 and \$470 million respectively in 2000–01). Most of the software R&D (76%) was undertaken by the computer services subsector'.

Public sector R&D base

Public sector ICT-related R&D expenditure for 2002–03 by field of research was \$326 million, supported by 3,244 research person/years. This represented just over 18% of total ICT expenditure, and 25% of the research personnel allocated.⁵⁷

Table 8. ICT related R&D expenditure by field of research, 2002-03

	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Higher Education</i>	<i>Private non-profit</i>
Research Personnel	9,673	968	108	2,168	32
Person years					
Research Expenditure	\$1,440	\$165	\$17	\$144	\$5
AUDm					

Source: ABS 8104.0, 2003.

Linkages to Industry

In general, linkages between Australian universities and Australian industry are extensive at the individual level,⁵⁸ but industry funding of research at universities is relatively limited. In 2000, 4.9% of Australian higher education expenditure on R&D was financed by industry compared with an OECD average of 6.2%, with the largest industry contributions flowing to medical and health sciences, engineering and technology, and biological sciences.

The low level of support is due at least in part to the relatively low level of Australian business expenditure on R&D, (other than in the ICT industry), and when this is taken into account, Australian businesses place a higher priority on funding R&D in the higher education sector than their counterparts in many other OECD countries. About 2.9% of industry financed expenditure on R&D is directed towards higher education, compared to an OECD average of 1.7%.⁵⁹

One characteristic of the software industry is that innovation linkages and sources tend to be limited by concerns over intellectual property and confidentiality, with firms concerned about sharing the knowledge that is their core asset.

One small survey of Australian software firms found that they relied heavily on internal sources for knowledge intensive services inputs, such as R&D and skills. More than 90% reported undertaking internal R&D. In contrast 50% commissioned no external R&D. When nominating their major external innovation partners, 78% of responding software firms nominated their customers, while less than 17% nominated universities and colleges, and 9% nominated public research institutes.⁶⁰

Key public sector ICT related R&D infrastructure

Larger ICT research centres are being encouraged through a number of initiatives, aimed to encourage the development of more critical mass in ICT R&D, and better co-ordination of research teams across Australia. There are a number of cooperative research centres (CRCs) which perform ICT R&D. Some of these have relevance to software development, as do several which are outside the ICT sector definition. Five of the ICT-related CRCs are now facing closure, having failed to win further government funding under the CRC program.

Table 9. ICT related CRCs.

<i>CRC name</i>	<i>Funded until</i>
Australian Photonics CRC (<i>uncertain future</i>)	2006
Australian Telecommunications CRC (<i>closing</i>)	2006
CRC for Enterprise Distributed Systems Technology (<i>closing</i>)	2006
CRC for Satellite Systems (<i>closing</i>)	2006
CRC for Sensor Signal and Information Processing (<i>closing</i>)	2006
CRC for Smart Internet Technology	2008
CRC for Spatial Information	2010
CRC for Technology Enabled Capital Markets	2008
Australasian CRC for Interaction Design	2010
CRC for Integrated Engineering Asset Management	2010

Source: CIIER Analysis.

The commitment to establish an ICT centre of excellence was announced as part of the January 2001 Australian Government Innovation Action Plan, Backing Australia's Ability. National ICT Australia Limited (NICTA) was established in May 2002. NICTA's role is to develop world-class ICT research and research training capabilities.

By early 2005, NICTA had three laboratories (two in Sydney and one in Canberra) and had established its headquarters at the Australian Technology Park in Eveleigh (Sydney). Two additional laboratories have become operational in 2005 in Melbourne and Brisbane, involving contributions and participation by the governments of Victoria and Queensland and four universities.

CSIRO has one of the longest traditions of continuous ICT R&D in the world. The CSIRO ICT Divisions (Telecommunications and Industrial Physics and Mathematics and Information Sciences) contributed to world patents in wireless leading to the successful \$600 million Radiata WLAN start-up.

In addition, about 30% of CSIRO's investment in ICT R&D occurs in its other, non-ICT divisions that have deep domain knowledge in such areas as exploration, mining and agribusiness (i.e. vertical markets).

In 2003 the Commonwealth Scientific and Industrial Research Organisation (CSIRO) established an ICT R&D Centre that will provide a whole-of-CSIRO focal point for the organisation's research, bringing focus on a few high impact areas of ICT research and facilitating the integration of CSIRO's core ICT research with the research being undertaken in application domains.

The Defence Science and Technology Organisation (DSTO) is focused on works to enhance Australia's defence capabilities. The DSTO spent \$28.5 million or 9.5% of its 2003–04 budget sourcing collaborative R&D and technical services from industry and research organisations. DSTO estimates that about 50% of its research is ICT-related, suggesting that at least 33% of Australia's public ICT research is oriented toward defence. In 2002, DSTO established a Technology Transfer & Commercialisation office to achieve greater industry take-up of DSTO's intellectual property, including for non-military applications.

Public sector research focus

Australia has adopted national research priorities which will have a significant impact upon public sector research funding and focus. The priorities, listed in full in annex 2, are aimed primarily at improving the quality of research and its contribution to Australia's future prosperity.

Each of these research priorities has the potential to engender software products as part of their research processes. (e.g. 'An Environmentally Sustainable Australia' will require measuring and monitoring software for water quality, energy usage, waste management etc., 'Promoting and Maintaining Good Health' is supported by health diagnostic and management software, 'Frontier Technologies' will require embedded software of many kinds, including scheduling, operational monitoring etc., and 'Safeguarding Australia' requires security software, recognition and encryption systems).

Whitehorse Strategic Group conducted a detailed study of public sector ICT R&D in June 2002 to provide a snapshot of the composition of the workforce and institutions involved, and the focus of ICT research.

The survey included all higher education institutions, cooperative research centres and other government funded organisations including CSIRO and DSTO. DSTO did not respond in detail, but cooperative research with DSTO was cited by a number of other respondents. An interview process involving 16 heads of university departments allowed for the collection of supplementary qualitative information.

Table 10. Whitehorse ICT R&D database, June 2002

	<i>VIC</i>	<i>NSW</i>	<i>QLD</i>	<i>SA</i>	<i>WA</i>	<i>ACT</i>	<i>TAS</i>	<i>NT</i>	<i>AUS</i>
Public ICT R&D institutions	9	12	7	5	4	3	1	1	42
Public ICT R&D Researchers (FTE)	766	672	380	326	176	92	26	2	2,440
Public ICT R&D Expenditure (AUDm)	46	40.3	22.8	19.6	10.6	5.5	1.6	0.1	148.1
Top 250 private sector ICT firms' R&D expenditure (AUDm)	226	214	191	0.3	0.0	1.5	0.0	0.0	632.4

Source: Whitehorse Strategic Group.

The table below identifies major ICT research focuses by the number of research centres. It is noticeable that the majority of the research focus areas selected have a generic ICT focus, rather than a focus on a particular vertical market.

Table 11. Focus of ICT research in the public sector by number of research centres, 2002

<i>Major focus</i>	<i>VIC</i>	<i>NSW</i>	<i>QLD</i>	<i>WA</i>	<i>SA</i>	<i>ACT</i>	<i>TAS</i>	<i>NT</i>	<i>Grand total</i>
Electronic commerce	4	1	1				1		7
Network modelling and performance	3		1		1	1			6
Signal processing	1	2	1		1				5
Software engineering	3	1		1					5
Telecommunications	2			2	1				5
Intelligent computing	1	1	1		1				4
Software maintenance	2	1		1					4
Web development		2	2						4
Broadband systems		2		1					3
Knowledge management	2	1							3
Mobile communication systems	2			1					3
Multi-media and Internet technologies	1				1			1	3

Source: Whitehorse Strategic Group.

R&D qualitative issues

Survey respondents also provided some qualitative comments, quoted below.

Box 4 Qualitative commentary

During the process of collecting the data in personal interviews numerous qualitative comments were gathered which highlight some of the key issues facing individual researchers.

One day in five is allocated to research and development work, but that doesn't happen as the staff are too busy teaching and managing their current teaching workloads.

'The notable increase in productivity represented through an increase in student to academic ratios, has been to the detriment of research and development effort within the university.'

'Post-graduate fee paying students are not interested in undertaking *research* work, they much prefer to do coursework, and as their student numbers increase, the numbers of suitable candidates to undertake *research* work diminishes.'

'All of my staff in this faculty undertake ICT research in some regard, they have to maintain a minimum quota and to gain advancement within the university.'

'The cross-faculty research work that is undertaken at this university is well coordinated, ensuring that we have the most appropriate people working on the research projects.'

'My division does not do any applied ICT research, it predominantly just supports other R&D areas, although we are often classified as a research area.'

'CRCs were conceived to be revenue positive arrangements, with the public institutions providing the R&D expertise, but as private firms pull out of CRC funding arrangements, the public institutions find themselves not only providing, but also funding the majority of the research work.'

'No research and development work is done any more within the traditional model within this University. All the research and development effort is conducted within the CRCs and the other specialist *research only* ICT areas within the University.'

Source: Whitehorse Strategic Group.

This commentary suggests that, while innovative public sector ICT research and development work is clearly taking place in Australia, there is a concern about the ability of staff to focus on research work.

The focus of university based R&D also seems to be concentrated more heavily on educating students in the conduct of research, and, despite the best intentions of staff to undertake the applied research necessary to explore innovative new developments, these intentions are often frustrated by the balancing act of having to meet their teaching commitments.

Linkages and greater engagement between industry and the public research sector has been a widely discussed issue. While not specifically investigating linkages with the ICT industry, Howard Partners⁶¹ observed that university-industry interactions are generally not out of line with those in other countries, save for the impact of lower R&D intensity of the business sector and the higher rates of overseas ownership and control of Australian industry.

In relation to the CRC program, data in DEST's report⁶² found that industry contributed proportionately more funding to ICT CRCs than to any other sector. While some ICT CRCs have actively engaged SMEs as core participants or through an alliance program (eg the

Smart Internet CRC), most core industry participants are large companies and many are foreign-owned MNCs.

In general, it was considered by participants in the industry focus groups that Australian universities are not sufficiently competent at developing a commercial focus, or of understanding the commercialisation of software products. Focus group attendees suggested that relationships between university researchers and Australian software firms, while they might exist at the individual level, became ‘difficult’ as soon as university administrations became involved, and felt that most Australian SME software firms simply did not have the energy or staff resources to survive the process.

CRCs, it was felt, while having a stronger commercial focus, tended to be primarily orientated to relationships with larger, multinational firms and were therefore less likely to provide any significant commercial impetus for Australian products.

Industry participants of the focus groups for CIIER’s research provided almost universally negative feedback on Australian Research Council (ARC) linkage grants, particularly in relation to the bureaucracy of the programs, and the inability of Universities to manage them effectively. It was a strongly held view that such grants would be far more effective if they were managed by the ‘industry partner’, with the universities’ role significantly reduced to that of technical resource.

The concerns expressed by the focus groups were consistent with a 1999 survey⁶³ which noted that public research organisations and SMEs are driven by different imperatives, and their respective goals, strategies and cultures are not in alignment. The same report also included comments from the public researcher perspective - SMEs were considered tactical, with no commitment to long term or deep R&D, and were unable to afford, and don’t value, the services of public research organisations.

Although SMEs and public research organisations and researchers clearly have differences in research objectives, timeframes and priorities, it appears that, while there may well be capacity within the research environment, SMEs and researchers are not taking advantage of this potential.

Positive outcomes

DEST (2003) reported that 21 ICT companies have directly spun out of Australian universities: 11 in communications equipment; four in computer software and information services; six in information and communications services. In 2000, of the 47 start-up companies formed as the result of licensing technology from universities, medical research institutes and CSIRO, 12 were ICT firms and another seven were ICT-related.

The CRCs have also been a source for ICT spin-offs, with 16 ICT companies formed between 1992 and 2001 from R&D in the seven ICT CRCs, including: 10 spin-offs from the Australian Photonics CRC, three from the Enterprise Distributed Systems Technology CRC, two from the Australian Telecommunications CRC, and one from the Centre for Sensor Signal and Information Processing.⁶⁴ However, there have also been difficulties, especially in such areas as IP (e.g. Victoria University and IP3 Systems).⁶⁵ What this data show is that there have been few pure software firms spun out of public sector research activities to date.⁶⁶

The skills base

ABS estimated that in June 2003 there were 107 094 people employed in computer services, of which 99,574 were employed in computer consultancy, of which 74,434 (75%) were ICT professionals.⁶⁷ The Whitehorse T250 for December 2004 shows that of this significant pool of talent only approximately 6850 people are employed by software developers (6200 in domestic companies, and 650 in internationally owned companies), of whom about 5000 are likely to be ICT professionals.

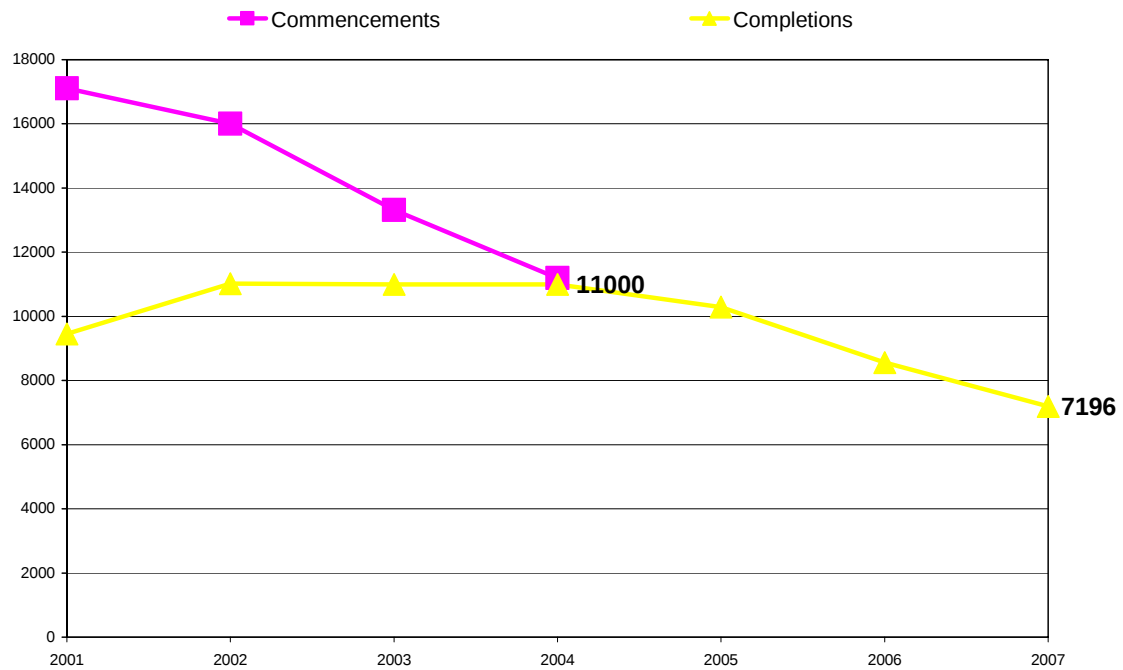
There are two main sources of mature skills for software development, skilled software developers working in other parts of the industry, or skilled migrants, either from overseas or from other industries. The movement of already skilled software people has tracked demand, with skilled people moving out of the software industry, responding to the rise of outsourcing.

Beyond the professional development programs of the Australian Computer Society (ACS), and commercial providers of training, most skills development in the software and services industry is ad hoc or on-the-job. Major vendors with a long history of internal training now seem to prefer recruiting the skills they need. The demise of structures such as the Training Guarantee, and the increased casualisation of the work-force, may have accelerated this trend. Self-funded training, of course, remains an option, but the recent ACS employment survey⁶⁸ found that nearly 58% of the unemployed gave cost as the major barrier preventing them from doing further training. However, time is not seen as an issue as this was nominated by only 4.4% of unemployed respondents. On the other hand 22.0%, compared with 2.6% for the survey as a whole, stated they had difficulty finding out what courses were available. There was also a marked increase in the number of unemployed respondents who said they had doubts training would boost their employment prospects (33.3% compared to 18.2%).

New inputs to the software skills pool, come either from 'entry-level' migrants, some of whom are educated in Australia, or from Australian university graduates. The projections in the charts below extrapolate university ICT commencements into anticipated completions, based on historical completion ratios (i.e. the historical percentage of course commencements who successfully complete the course).

They show that, on current settings, both domestic and international university graduates can supply a diminishing number of entrants to this skill pool over the next three years, and that, unless there are significant increases in commencements in the immediate future, this situation will continue, with a declining number of graduates entering the industry.

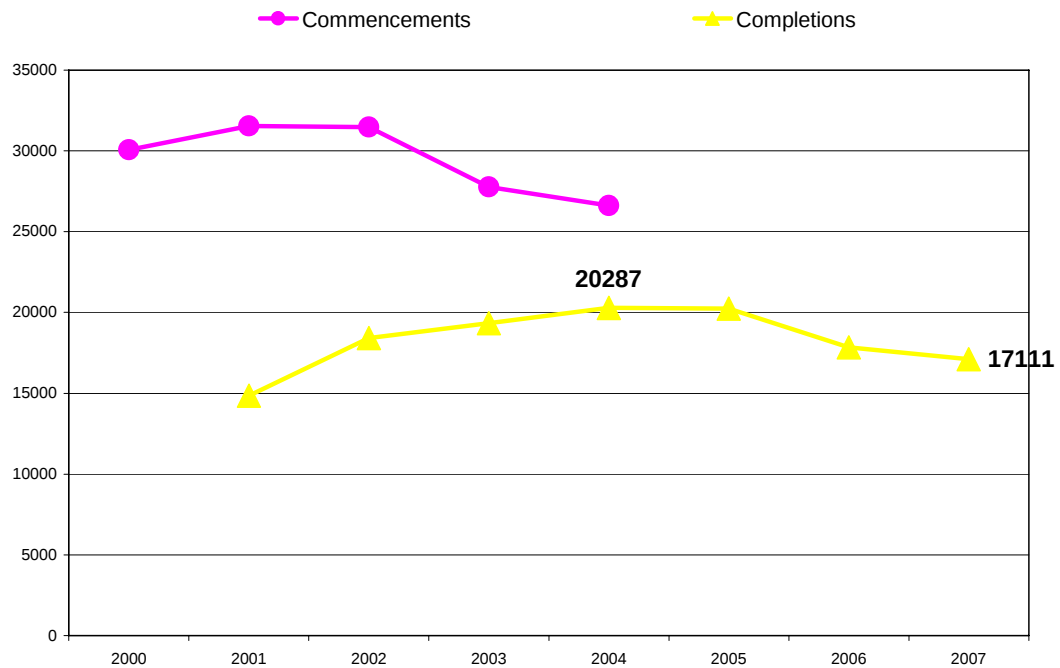
Figure 23. University ICT intake and graduations (Australian residents), 2001–07



Source

e: DEST, CIER Analysis.

Figure 24. University ICT intake and graduations (total), 2001-07



Source: DEST, CIER Analysis.

The charts above plot the number of new university enrolments in ICT and graduations (with projections to 2007) for Australian resident and all ICT students (international and Australian resident) at Australian universities. While they both indicate that the output of graduates in ICT has been static over the last few years, and, on the basis of current enrolments and commencements, we project that the number of Australian-resident graduates will decline in the future.

This reduction in the flow of graduates has taken place in a climate of cut-backs in educational funding, and consequent financial pressure on Universities to generate fees from overseas students. This reduction in graduates has significant implication for the ready supply of competent entry-level software developers, which can, otherwise, only be supplied through migration.

Conclusions on the innovation base

Whilst the business and operating environment for the Australian software industry is comparable to many other parts of the world, and recent initiatives in R&D are considered likely to improve the situation, the difficulty in gaining access to appropriate capital, concerns about skilled labour supply, and *the lack a of strong relationship between the Australian software industry and the public sector research base*, continue to require attention in order to maximise Australia's potential in this field.

Annex 1. Detailed tables and charts

Table 12. Australian software trade, 1994 to 2004 (AUDm)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Exports											
Software products	94.3	108.1	57.6	29.2	46.8	33.5	36.6	41.2	77.6	85.6	94.7
Royalties & fees	179.5	187.5	192.5	215.5	262.0	311.5	302.5	204.5	142.0	145.0	142.0
Total exports	273.8	295.6	250.1	244.7	308.8	345.0	339.1	245.7	219.6	230.6	236.7
Imports											
Software products	740.9	673.9	450.9	410.1	578.8	569.4	549.8	475.4	507.7	504.7	539.2
Royalties & fees	252.5	221.0	236.5	266.0	307.0	387.0	385.0	356.0	412.0	469.1	467.0
Total imports	993.4	894.9	687.4	676.1	885.8	956.4	934.8	831.4	919.7	973.9	1,006.2
Balance											
Software products	-646.6	-565.7	-393.3	-381.0	-532.0	-535.9	-513.2	-434.3	-430.1	-419.1	-444.5
Royalties & fees	-73.0	-33.5	-44.0	-50.5	-45.0	-75.5	-82.5	-151.5	-270.0	-324.2	-325.0
Total balance	-719.6	-599.2	-437.3	-431.5	-577.0	-611.4	-595.7	-585.8	-700.1	-743.3	-769.5

Notes: Software products include recorded and recordable media of the types suitable for software. Software royalties & fees for 2003-04 are estimated, based on software share of total royalties and license fees in previous year. All data are current prices.

Sources: ABS (various years) *Balance of Payments and International Investment Positions, Australia*, Cat No 5363.0, Canberra; ABS (various years) *International Trade in Goods and Services, Australia*, Cat No 5368.0, Canberra; ABS (various years) *Balance of Payments and International Investment Positions, Australia*, Cat No 5320.0, Canberra; DFAT (various years) *Trade in Services Australia*, Department of Foreign Affairs and Trade, Canberra; and ABS unpublished data. CSES Analysis.

Data for figure 10—Australian software and services employment by HO location, sample group Dec 2004

Country	Systems and network engineering and integration	Software products	Other services	Facilities mngt and outsourcing	Education and training	Content and value-add
USA	5526	3217		15139		
Australia	2598	6157	42	3831	28	60
France	2635					
Canada		796				
UK		49		950		
India	380			110		
Germany		350				
Netherlands	626					

Data for figure 11—Australian software and services revenue (AUD millions) by HO location, sample group Dec 2004

Country	Teleco Infrast. & basic services	Systems network eng'g & integ'n	Strategy & Planning	Software Products	Other services	ITT h'ware & comp'ts	Facilities mngt & outs'g	Education & Training	Content & value-add
USA		963.00		1294.00			4742.63		
Australia	20.65	489.03		1612.19	7.00	49.00	854.00	1.74	6.94
France		700.00							
Canada				290.30					
UK				8.80			210.00		
India		49.00					115.00		
Germany				132.00					
Netherlands		110.00							
Singapore		9.00							

Data for figure 16: Market selection by software companies—location of head office

	NSW	Vic	WA	Qld	Tas	SA	ACT
IT	32	31	7	4	7	7	2
Communications	30	27	8	4	2	3	2
Government	35	18	4	7	5	2	4
Finance/insurance	37	22	3	1	3	3	3
Utilities	21	18	4	5	2	3	
Transport	20	14	4	6	1	4	2
Education	16	11	7	6	6	1	1
Retailers	21	15	2	4	2		
Health	13	9	4	3	2	1	2
Mining	17	7	4	4	2		
Construction	9	9	1	1	2		
Other markets	9	2	1		3	2	3
Wholesalers	9	2	1		3	2	3
Tourism	6	5		3	3		
Entertainment	8	3	1		1	1	
Agriculture	4	3		1	3	1	1
Property	3	2		1	1	1	

Endnotes

- ¹ Vock, P. (1997) 'Swiss Position Paper on Mapping Innovative Clusters,' OECD Workshop, Amsterdam, October 1997.
- ² Spielkamp, A. & Vopel, K. (1999) 'Mapping Innovative Clusters in National Innovation Systems,' in OECD *Boosting Innovation: The Cluster Approach*, OECD, Paris.
- ³ See Hobday, M., Rush, H. and Tidd, J. (2000) 'Innovation in complex products and system', *Research Policy* 29(2000), pp793-804 and related papers in that special issue of *Research Policy* for an overview and introduction.
- ⁴ Hobday, M., Rush, H. and Tidd, J. (2000) 'Innovation in complex products and system', *Research Policy* 29(2000) pp793-804.
- ⁵ Hobday, M., Rush, H. and Tidd, J. (2000) 'Innovation in complex products and system', *Research Policy* 29(2000) pp793-804.
- ⁶ Australian Government (2005) *Knowledge Intensive Service Activities in the Software Industry in Australia*, OECD KISA Project, p34.
- ⁷ 1969 Australian Edition of Data Trend.
- ⁸ Whitehorse Top 250, Dec 2004.
- ⁹ DCITA (2002) *Enabling our Future*, Department of Communications, Information Technology and The Arts, Canberra.
- ¹⁰ Productivity Commission 2004, *ICT Use and Productivity: A Synthesis from Studies of Australian Firms*, Commission Research Paper, Canberra.
- ¹¹ Howard Partners 2005, *Digital Factories: the Hidden Revolution in Australian Manufacturing*, A Study commissioned by the Department of Communications, Information Technology and the Arts
- ¹² DCITA (2002) *Enabling our Future*, Department of Communications, Information Technology and The Arts, Canberra.
- ¹³ ABS 8126-0
- ¹⁴ Whitehorse Strategic Group 'Top 250' industry model. The primary mechanism used to provide the data for the model is a detailed six-monthly survey of ICT firms in Australia, known as the 'Whitehorse Top 250'. The methodology employed includes a questionnaire both mailed and emailed out to respondents and direct verification telephone contact with a significant proportion of the survey base. The survey is supplemented by web-searches, press reports, Annual Reports, and other public sources of data, and the data is used to populate a statistical model of the Australian ICT industry based upon paradigms derived from the most up-to-date ABS evaluations.
- ¹⁵ In their 2002-03 survey of the ICT industry, the ABS allocated approximately 20,000 sole trader/contractors to the Australian ICT industry for the first time, based upon their inclusion in ATO lists derived from GST registrations. It is likely that they had previously been considered to be casual or contractual workers, and included within ICT professional employment, but not classified to the ICT industry.
- ¹⁶ Digital Planet 2004, WITSA, Global Insight Inc
- ¹⁷ ABS 8126-0, 2002-3 Data, September 2004.
- ¹⁸ OECD (2004) *Information Technology Outlook 2004*, Organisation for Economic Cooperation and Development, Paris, p53.
- ¹⁹ ABS 8126-0, AIIA reports
- ²⁰ ABS 8126.0 2001, 2002-3
- ²¹ Whitehorse Top 250 June 2005
- ²² Whitehorse presentation to F3 Mapping Group, July 2002.
- ²³ Whitehorse Top 250 Dec 2004.

- ²⁴ Sensis special report for DCITA, ICT production in Australian SME's Nov 2004.
- ²⁵ Whitehorse Study on Outsourcing and Offshoring, ACS, 2003.
- ²⁶ European Commission Community Research, Fifth framework, Technological Implementation Plan. The TIP is information that most EU R&D contractors have to submit as a contractual obligation. It describes the results of the project and the plans that the partners have to use those results and to encourage others to use them.
- ²⁷ General Information Technology Contract (GITC) Terms and Conditions.
- ²⁸ See "The Origins of Modern Computers", Trevor Pearcey, and other sections in "Computing in Australia", Bennett et al, Australian Computer Society 1994
- ²⁹ Gartner; IDC; Saugatuk.
- ³⁰ "In early February 2004, the Australian Government concluded negotiations for a Free Trade Agreement (FTA) with the United States, the world's largest economy. It is truly a landmark deal, the most important bilateral economic agreement ever undertaken by Australia. When the Agreement comes into force, potentially in early 2005, it will create significant new benefits and opportunities for Australian exporters, including: Elimination of duties on over 97% of US tariff lines for Australia's non-agricultural exports (excluding textiles and clothing); Improved access for Australian agriculture, with 66% of agricultural tariff lines going to zero from day one and a further 9% cut to zero within four years; Full access for the first time for Australian goods and services to the \$200 billion market for US federal government procurement; and Enhanced legal protections that guarantee market access and non-discriminatory treatment for Australian service providers in the US market, with only limited exceptions." DFAT website.
- ³¹ BusinessWeek Online May 10, 2005, Jim Kerstetter, Technology editor.
- ³² Fostering the Australian Software Industry February 2004, Software Engineering Australia National Limited; Bladier.
- ³³ Developing Australia's ICT Industries 2003, Information Age, Singleton.
- ³⁴ General Information Technology Contract (GITC) Terms and Conditions.
- ³⁵ Australian Government Use of ICT: A New Governance and Investment Framework, Management Advisory Committee, Canberra, 2002, p11
- ³⁶ Digital Planet 2002, "The Global Information Economy", WITSA.
- ³⁷ Thorburn, L., Langdale, J. & Houghton, J.W. (2002) *Friend of Foe? Leveraging Foreign Multinational in the Australian Economy*, Australian Business Foundation, Sydney.
- ³⁸ Whitehorse Top 250, Dec 2004.
- ³⁹ PSEIC (2000) *Australia's Information & Communications Technology Research base, Driving the New Economy*, Prime Ministers Science, Engineering, and Innovation Council, Canberra, November 2000.
- ⁴⁰ UNCTAD/GATT technical workshop, "Foreign Trade in Information technology", 1992.
- ⁴¹ BIE (1989) *Selling Packaged Software Overseas*, Bureau of Industrial Economics, Canberra.
- ⁴² ABS (2004) *Venture Capital: Australia*, Australian Bureau of Statistics, Cat No 5678.0, Canberra.
- ⁴³ Connors, E. (2005) 'Dearth of capital for start-ups,' *Australian Financial Review*, 26 July 2005, p29.
- ⁴⁴ AIIA Submission to the Review of the Venture Capital Industry June 2005, Australian Information Industry Association.
- ⁴⁵ DEST (2003) *Mapping Australian Science & Innovation*, Department of Education, Science & Training, Canberra, p137.
- ⁴⁶ ASOCIO, the Asian Oceania Computing Industry Organisation, the regional body for Asia and Oceania to which industry organisations such as AIIA belong.
- ⁴⁷ Australian Computer Society submission to China FTA Task-Force.
- ⁴⁸ Standards Australia (<http://www.standards.org.au/>).
- ⁴⁹ Houghton, J.W. (2003) *Australian ICT Industries Update 2003*, Australian Computer Society and Centre for Strategic Economic Studies, Sydney & Melbourne.

- ⁵⁰ Houghton, J.W. (2003) *Australian ICT Industries Update 2003*, Australian Computer Society and Centre for Strategic Economic Studies, Sydney & Melbourne
- ⁵¹ ABS (various years) *Research and Experimental Development: All Sector Summary, Australia*, 8112.0, Canberra; and ABS (various years) *Research and Experimental Development: Business Enterprises, Australia*, 8104.0, Canberra.
- ⁵² Houghton, J.W. (2003) *Australian ICT Industries Update 2003*, Australian Computer Society and Centre for Strategic Economic Studies, Sydney & Melbourne
- ⁵³ ABS (various years) *Research and Experimental Development: All Sector Summary, Australia*, 8112.0, Canberra; and ABS (various years) *Research and Experimental Development: Business Enterprises, Australia*, 8104.0, Canberra.
- ⁵⁴ DEST (2003) *Mapping Australian Science & Innovation*, Department of Education, Science & Training, Canberra, p306.
- ⁵⁵ DCITA *An Overview of the Australian ICT Industry*
http://www.dcita.gov.au/_data/assets/pdf_file/10451/Overview_of_the_Australian_ICT_Industry_02-03.pdf
- ⁵⁶ http://www.dcita.gov.au/_data/assets/pdf_file/10446
- ⁵⁷ ABS (2004) *Research and experimental development: All sector summary 2002-3*, Cat. No. 8112.0, Canberra.
- ⁵⁸ DEST (2004) *Review of Closer Collaboration between Universities and Major public Research Agencies*, Department of Education, Science and Training, Canberra.
- ⁵⁹ DEST (2003) *Mapping Australian Science & Innovation*, Department of Education, Science & Training, Canberra, p254.
- ⁶⁰ Australian Government (2005) *Knowledge Intensive Service Activities in the Software Industry in Australia*, OECD KISA Project.
- ⁶¹ Howard Partners 2005, *Digital Factories: the Hidden Revolution in Australian Manufacturing*, A Study commissioned by the Department of Communications, Information Technology and the Arts
- ⁶² Mapping Australian Science and Innovation p258, DEST
- ⁶³ The IT engine room, SMEs in Australia's ICT industry, DCITA; Benson
- ⁶⁴ DEST (2003) *Mapping Australian Science & Innovation*, Department of Education, Science & Training, Canberra, p309.
- ⁶⁵ IP3 Systems (2004) *Damages Claim Exceeds \$55m*, (<http://www.ip3systems.com/news/news-press.html>).
- ⁶⁶ For example, the ARC's *National Survey of Research Commercialisation* cites just 3 examples relating to software. See ARC, CSIRO & NH&MRC (2002) *National Survey of Research Commercialisation*, Australian Research Council, Canberra.
- ⁶⁷ Australian Bureau of Statistics (2004) *Information and Communication Technology Australia*, Cat. No. 8126.0, Canberra.
- ⁶⁸ ACS 2005 Employment Survey <http://www.acs.org.au/attachments/03employsurvey4public.pdf>

Selected Bibliography

The bibliography below identifies some of the sources used in this study.

ACS Submission to ICT Industry Plan—Victoria 2004

Advanced software development environments, 1990, Eureka Software Factory—Berlin; Dennis

Agenda for Prosperity—Information Industries in NSW and Australia, Australian Centre for Innovation and International Competitiveness 1989; Johnston, Goodwin

AIIA Submission to ICT Industry Plan—Victoria 2004

Australia: Winning in the Global ICT Industry, 2003. DCITA; McKinsey & Company

Australian ICT Performance—Leader or Laggard', Information Age, IDG Communications, Sydney (April 2002). Houghton

Australian ICT Trade Update (multiple years to 2005), Australian Computer Society/CSES; Houghton

Australian Microelectronics and Software Mission to Europe 1990, DITAC; Cooper, Dennis

Australian software achievements, 1990, Austrade—Brussels; Dennis

Australia's changing ICT industrial landscape 2004, Information Age; Singleton

Australia's Information Economy—The Big Picture 2002, NOIE/Allen Consulting/Monash University,; David Charles, Duncan Buckeridge

Ballarat IT 2010—ICT economic development, 1999, Deloitte/Econsult/Whitehorse Strategic Group; Dennis, Goble, Cotterill et al

Canada's Advanced Technology Business Plan 2003, CATA; de la Mothe

Commerce in Content—Building Australia's International Future in Interactive Multimedia Markets, DISR/CSIRO/Cutler and Company 1994; Buckeridge, Cutler

Computer Software Survey Mission to Japan 1984, DITC, Dept of Trade; Claringbold, Dennis, Follett, Draney

Connecting Trading Partners 2002, National Supply Chain Reform Task-Force; McLean et al

Developing Australia's ICT Industries 2003, Information Age ;Singleton

Developing High Technology Enterprises in Australia 1983, Australian Academy of Technological Sciences; Espie

- Development and Future of Corporate software 1986, Australian Society of Accountants—Singapore; Dennis
- Development and future of the Australian Software Industry 1985, 1st Pan-Pacific Computer Conference—Melbourne; Dennis
- Development plans and prospects for the software industry 1989, ASOCIO—Singapore; Dennis
- Digital Planet 2002, the Global Innovation Economy, WITSA; IDC
- Directions for Industry Policy in Western Australia within the Global Knowledge Economy 2002, Western Australian Technology & Industry Advisory Council; Houghton
- Drivers and Inhibitors in the Application of Communication and Information Technology in Australia and Five Asian Nations' Proceedings of the Pacific Telecommunications Council 16th. Annual Conference, PTC'94, 1994; Houghton, Mansfield, Una and Joseph
- eGovernment strategy for Local Government 2002, Multimedia Victoria/Whitehorse Strategic Group; Dennis
- Emerging trends in Asia-Pacific ICT Markets 2005, KPMG; Matuszak
- ENABLING OUR FUTURE, A Framework for the information and communications technology industry, Framework for the Future Steering Committee to the Minister for Communications, Information Technology and the Arts, April 2003
- Entering the European Software Market - Strategic Analysis, INPUT 1983, Cunningham
- Euroview ICT Market outlook 2004, Ovum; Holway
- Export Development Strategy—Computer Software 1987, Austrade; James, Dennis
- Exporting Computer Software to Asia, NSW Computer Industry Advisory Council/ NSW DIDD 1987; IDC Australia
- Fostering the Australian Software Industry, Software Engineering Australia 2004; Bladier
- Friend or Foe? Leveraging Foreign Multinationals in the Australian Economy, Australian Business Foundation 2002; Houghton, Thorburn, Langdale
- From Telehealth to e-Health, NOIE/DCITA/John Mitchell & Associates 1989; Mitchell
- Globalisation of the ICT sector in OECD Information Technology Outlook 2004, OECD, Paris, December 2004, Houghton
- Globalisation of the ICT sector, in Information Technology Outlook 2002, OECD; Houghton
- ICT Production in Australian SMEs 2004, DCITA, Sensis, Sweeney Research
- Information Industries Update 2001, ACS/CSES; Houghton
- Information Technology in Australia, DST 1984; W.D. Scott and Arthur D Little

- Information Technology Industry in Victoria: Sector Study, Victoria-Australia, Office of Trade and Investment, Government of Victoria, 1992; Paltridge, Houghton, and Northfield
- Investment in the Software Industry, 1988, Austrade seminar—Tokyo/Osaka; Dennis
- IT Spending predictions roundup 2004, Bitpipe; Zimmerman
- Mapping the Information Industries 1996, Productivity Commission; Houghton, Pucar, Knox
- Networked readiness Index 2003-4, INSEAD; Dutta, Jain
- Piracy Study 2004, Business Software Alliance and IDC
- Profile of Information Industries in NSW 1999, NSW Dept of State Development/ Whitehorse Strategic Group; Dennis
- Promotion of Foreign Trade in Information Technology. UNCTAD/GATT 1992, Wells; Bojanowski; Dennis et al.
- Purchase Plans for ICT 2005, Bitpipe
- Research Priorities in Communications and Information technology 1988, DITC; Garrett-Jones, Lamond, Thomas
- Review of Austrade Export Development Strategy- Computer Software and services 1989, Ernst & Young; Dennis
- Review of Victorian Information Industries, MultiMedia Victoria/Whitehorse Strategic Group; Dennis, Goble et al
- Selling Packaged Software Overseas, Bureau of Industrial Economics 1989; Gallagher
- Software Industry Research Report, Software Engineering Australia 2003, Whitehorse Strategic Group Ltd; Dennis, Taylor, Librizzi
- Software Industry Trade Mission to Singapore and Japan 1983, ACS/ASHA; Green
- Software Marketing Consortia/Software Export Centre 1990, Austrade/Ernst & Young; Dennis
- Spectator or Serious Player 1997, Information Industries Taskforce/Allen Consulting/Allen & Buckeridge; Charles, Allen, Buckeridge
- Status of the Australian Information Industry 1990, IIIC—London; Dennis
- Stocktake of Australia's Information Industries 1998, STM Consulting /DIST; James, Hont
- Strategic Industry Development Agreement Program Discussion Paper, DCITA 2001
- Structure and Strategy in the Software Market, Australian Computer Commentary, 7(3), September 1992, Houghton
- Study of Offshoring and Outsourcing, Australian Computer Society/Whitehorse Strategic Group; Dennis, Taylor

- Tasmanian ICT Industry Survey and Analysis, Intelligent Island/Government of Tasmania 2004; Dennis, Taylor
- The Australian Software Industry 1987, AITC; Morris, Tardiff, McAllister
- The Export of Software, Victorian Dept of Industry, Technology, Resources/ACS/ASHA; Reed, Eisen, Austin et al
- The Information and Communications Services Industry 1989, Austrade/DITC; IDC Australia
- The IT engine room, SME's in Australia's ICT industry, DCITA; Benson
- The Software Industry in Australia 1982, ASHA; Dennis
- Trade Performance: Are we making IT in Australia?, Australian Communications, February 1997; Houghton, Pucar
- Translation and Export of Computer Software to Asia, NSW Dept of Business and Consumer Affairs 1988; IDC Australia
- Trends in Software Development 1987, Comdex - Sydney; Dennis
- Victoria's e-Learning Sector 2003, Whitehorse Strategic Group; Taylor
- What Game Are We In? Framing Policy Options for the Information Industries' in The Global Information Economy: The Way Ahead Report of the National Information Industries Taskforce. 1997; Houghton, Flaherty
- World-Wide Work, Globally Distributed Expert Business Services, DISR/Telesis; Morris

**Centre for Innovative Industry Economic
Research Consortium**

**The Australian software industry and
vertical applications markets:
Globally competitive and
domestically undervalued**

Part B
Vertical markets 1–5

Table of contents—Part B Vertical markets 1–5

Vertical Market Mapping	106
Selecting the verticals	106
The nature of software markets	106
Defining software verticals	107
Selected vertical markets	107
Education	109
The education software product system	109
Education expenditures	111
The education software market	114
Education software suppliers	134
Innovation base and support infrastructure	141
Education market conclusions	143
Government	145
The government software product system	146
E-government markets	147
The e-government software market	159
E-government software suppliers	168
Innovation base and support infrastructure	169
Government market conclusions	169
Manufacturing	172
The manufacturing software product system	172
The manufacturing market	176
The manufacturing software market	182
Manufacturing software suppliers	187
Innovation base and support infrastructure	193
Opportunities	195
Manufacturing market conclusions	203
Minerals	205
The minerals software product system	205
Minerals markets	206
The minerals software market	208
Mining software suppliers	215
Innovation base and support infrastructure	226
Minerals market conclusions	229
Trade and commerce	230
The trade and commerce software product system	230
Trade and commerce markets	231
The trade and commerce software market	239
Trade and commerce software suppliers	246
Innovation base and support infrastructure	249
Trade and commerce market conclusions	249

Figures

Figure 1.	The education software product system.....	111
Figure 2.	Public expenditure on education as a share of GDP, 2000 (per cent)	113
Figure 3.	Ratio of students to computers in schools, 2001.....	114
Figure 4.	The education vertical software market map	136
Figure 5.	Categorising e-government services (with examples)	145
Figure 6.	The government product system.....	147
Figure 7.	Features currently offered on government portals (percentage adoption)	150
Figure 8.	UN Member countries web portal evaluation.....	150
Figure 9.	Australian government software and services market	153
Figure 10.	E-government vertical software market map	168
Figure 11.	Market potential in e-government software	171
Figure 12.	The manufacturing software product system	173
Figure 13.	Manufacturing vertical software market map	188
Figure 14.	Competing routes to sub-vertical markets	198
Figure 15.	Total ICT spending—manufacturing (selected countries)	202
Figure 16.	The minerals software product system.....	205
Figure 17.	Global consumption and production of oil, 2003–04.....	207
Figure 18.	Global consumption and production of gas, 2003–4.....	207
Figure 19.	Exploration spending in Australia: minerals.....	209
Figure 20.	Minerals production trends, 1998–99 to 2002–03.....	209
Figure 21.	Exploration spending in Australia: oil and gas	210
Figure 22.	Major mining regions.....	212
Figure 23.	ICT spend and Australian software exports by region.....	213
Figure 24.	Global ICT spending in mining, 2004 (USDm).....	214
Figure 25.	Estimated exports of mining computer services, 2003–04 (share)	215
Figure 26.	Mining technology services revenues, 2003–04 and estimated 2004–05	216
Figure 27.	Minerals vertical software market map.....	225
Figure 28.	The trade and commerce software product system.....	231
Figure 29.	E-commerce—value and percentage of transactions sector.....	232
Figure 30.	US e-commerce retail sales as a percentage of total retail sales	233
Figure 31.	European online purchasing and supply chain index, 2004	234
Figure 32.	Trade and commerce vertical software market map	248
Figure 33.	Overall opportunity for Australian firms	252

Tables

Table 1.	Vertical markets selected.....	108
Table 2.	Public and private education expenditures per student, 2000 (USDm)	112
Table 3.	Key market characteristics by activity area	127
Table 4.	US e-learning stock tracker, June 2005	135
Table 5.	Some e-learning firms and products.....	137
Table 6.	Some e-research firms and products.....	140

Table 7.	e-Government readiness and maturity rankings, 2004.....	149
Table 8	Asia-Pacific e-government spending forecasts, 2005-07.....	156
Table 9.	e-Government spending in Europe (USDm).....	158
Table 10.	Market segment trends.....	160
Table 11.	UN global e-government survey, 2004.....	161
Table 12.	Australian firms in the infrastructure segment.....	161
Table 13.	Australian firms in the security segment	163
Table 14.	Australian firms in the specialist systems segment.....	165
Table 15.	Australian firms in the CRM segment	166
Table 16.	Australian firms in the tools segment	167
Table 17.	Overall SWOT for Australian e-government firms	170
Table 18.	Manufacturing industry ICT expenditures, 2003 (USD billion).....	176
Table 19.	Australian manufacturing software expenditures (USD million)	176
Table 20.	Regional per annum growth in ICT expenditure (all sectors).....	177
Table 21.	Manufacturing sector ICT expenditure, 2005 (USDm)	177
Table 22.	The 21 business logics	182
Table 23.	A 'Basic' Enterprise Resource Planning (ERP) System.....	184
Table 24.	Additional modules relevant to the manufacturing vertical.....	186
Table 25.	Specialist applications relevant to the manufacturing vertical.....	187
Table 26.	Australian software firms in the manufacturing vertical market	189
Table 27	Some minerals software firms and products.....	218
Table 28.	Minerals software firms by area of activity	221
Table 29	Some oil and gas software firms and products	222
Table 30.	Some factors influencing e-procurement in different sectors	235
Table 31.	E-procurement drivers and barriers	235
Table 32.	Australian firms in the e-commerce platform segment.....	241
Table 33.	Australian firms in the payment gateways segment	243
Table 34.	Australian firms in the supply chain and logistics segment.....	245
Table 35	Australian firms in the customs compliance segment.....	246
Table 36.	Summary of trends and status of market segments.....	247
Table 37.	Australian trade & commerce software SWOT	251

Boxes

Box 1.	Use of ICT in UK further education, 2004.....	115
Box 2.	Educational technology fact sheet: United States.....	116
Box 3.	National Report on Schooling in Australia, 2000.....	117
Box 4.	Children's use of computers and Internet in Australia	118
Box 5.	Scope of ICT in Australian universities	120
Box 6.	Hardcat at Edith Cowan University.....	125
Box 7.	The UK experience.....	129
Box 8.	Proteome Systems	130
Box 9.	Software from DSTC (Distributed Systems Technology Centre)	132
Box 10.	Creative Windoware.....	135

Box 11.	QSR.....	139
Box 12.	Audio-Read	141
Box 13.	E-Learning Software Lacks Academic Direction.....	142
Box 14.	Example of a niche application - Seeing Machines.....	175
Box 15.	Airframe – an example of the SaaS model.....	181
Box 16.	The relationship between MRP, MRP II, ERP and APS.....	183
Box 17.	Mincom profile.....	196
Box 18.	Specialist Applications – manufacturing and control systems	201
Box 19.	Genesis 2000 project	227
Box 20.	Government initiatives supporting e-commerce.....	236
Box 21.	RFID: A new component in Supply Chain Management.....	237
Box 22.	Innovit Pty Ltd	248

VERTICAL MARKET MAPPING

Selecting the verticals

This section presents a brief summary of the considerations in the selection of the vertical application markets to be studied. It is followed by an analysis of those verticals.

The nature of software markets

Vertical software markets represent market potential rather than a finite defined market. A potential vertical software solution can be supplied in many ways. It may be supplied by ‘vertical’ software products, by horizontal software products, by in-house developed software, by manual systems, by outsourced services, etc. This multitude of ‘supply’ options means that it is misleading to talk about ‘vertical software product’ markets, as if they were able to be easily and separately quantified.

The vertical market is the whole sector’s potential ICT purchase intention (i.e. what could potentially be supplied by software product), not merely that component of it currently supplied by specifically designed vertical software.

This distinction becomes more significant when we are considering future markets. A supply-mix change, either towards the supply of software product, or away from software products to a services orientation, can, in some cases, be more significant than a total market size change.

As an example, a supply-mix change occurs when large organisations choose to outsource significant parts of their ICT, such as payroll. When this happens the market for payroll software products and systems may diminish due to the supply-mix change, even though the total number of payrolls being processed (i.e. the payroll market) may have increased.

There is no necessary connection between growth in a vertical market (e.g. mining) or even an activity that is related to a vertical application (e.g. e-learning) and the demand for software. In some cases growth of vertical market activity means growth in software market (e.g. mining), while in others, expenditure limitations and cuts (e.g. health or government) and demands for efficiency gains (e.g. energy) can provoke increased spending on software.

For the purpose of this project we have, therefore, concentrated on defining vertical markets, and identifying where both the potential market size and the supply-mix is potentially positive for vertical software products.

Defining software verticals

The most common approach to defining ‘verticals’ is by reference to standard industry classifications, with an industry (e.g. automotive manufacturing) or industry sector (e.g. manufacturing) defining the vertical—as a grouping of clients or customers with similar needs. However, this does not always correlate to the way in which the software industry relates to these markets. In some case ‘verticals’ might be vertical applications (e.g. e-learning or e-security) which span industry sectors. Hence, vertical applications markets relate to:

- (i) vertical markets for applications, with markets relating to specific industry sectors (e.g. mining, government, health,); and
- (ii) vertical applications markets relating to specific applications and activities (e.g. e-learning, e-payments).

We have deliberately selected a range of vertical markets that include both vertical applications markets and vertical market sectors, in order to explore the full breadth of issues.

Selected vertical markets

The market verticals selected for analysis are listed in the table below, together with the designated segments within the major verticals.

The choice of the final detailed evaluation sectors was based upon consideration of the three key factors: (i) Australian capability, (ii) Australian track-record, and (iii) market demand, coupled with market contestability (i.e. the ability of Australian firms to compete). The selected verticals are: education, energy, government, health, ICT, manufacturing, minerals, and trade and commerce.

It is important to note that the vertical markets and market segments that have been chosen for detailed investigation do not encompass the range of software development in Australia. They are merely indicative of a range of vertical market activities.

Table 1 Vertical markets selected

<i>Major vertical</i>	<i>Designated market segments</i>
Education	E-learning applications E-research applications Other (business and administrative systems)
Energy	Operational efficiency Built environment Trading and risk systems Asset management systems RTAC GFAS CIS and billing
Government	Basic infrastructure Tools—payment gateways, and taxation Tools—content management Tools—software development Specialist departmental Specialist geospatial Security
Health	Clinical (clinical systems, GP systems Clinical support and other (pharmacy, pathology, radiology, nutrition, community health) Medical devices Patient administration (PAS, GP practice management) Finance, supply and administration (procurement and supply, payroll) infrastructure (security, messaging etc)
ICT	Data management Business Software development Web/Internet
Manufacturing	Discrete (e.g. ERP) Process (e.g. industrial automation)
Minerals	Mine management Exploration, geological survey and mapping Telemetry Mine planning
Trade & commerce	E-commerce platforms Payment gateways Supply chain and logistics Customs compliance

Source: CIIER Analysis.

Education

As in other information and knowledge intensive activities, ICT plays a significant role in education. Software, related content (multimedia) and services supplied to education sector users are of three main types:

- *Business management*—e.g. accounting, financial, resource planning and management, student records and research administration;
- *Teaching and learning tools (e-learning)*—e.g. online lesson outlines, teacher-student communication, computer assisted instruction, integrated learning systems, computer based assessment tools; and
- *Research and information infrastructure (e-research)*—e.g. library and content management, database and archive management, copyright and digital rights management, communications, access, identification and authentication systems, data grids, middleware, specialist analysis systems, web publishing and e-publishing.

Education can be thought of as a vertical market within which there is use of both horizontal applications (e.g. ERP) and a number of vertical applications that are to varying degrees vertical market applications used in the education sector and vertical applications used for specific activities, but are not necessarily sector specific (e.g. e-learning, which is central to the education sector, but both used and developed across all industries).

As is the case in the trade and commerce chapter, the focus of education vertical market analysis is primarily upon activities (i.e. vertical applications) that span industry sectors, rather than the education sector vertical market *per se*. However, there is a secondary focus on the important vertical market application of horizontal applications in business administration within the education sector.

The education software product system

The education software product system features some powerful players on the demand-side, with national and state education authorities, purchasing and licensing consortia, and product review and accreditation bodies acting as key gatekeepers.¹ Market players operate within a range of technical and quality standards, digital rights management and content access management regulations.²

Standards for e-learning relate primarily to systems interoperability and content, while those in e-research tend to relate more to metadata, handling and messaging. In both cases, there are important linkages between the research base and the development of standards in particular areas, with some research centres focusing considerable attention on active participation in international standards developments.

There are a range of advisory and support agencies.³ A key feature of most e-learning and e-research systems, be it in distance learning or research computing grids, is a heavy dependence upon the development of, and access to, affordable high-end

broadband access networks.⁴ There are many public and private sector entities involved in the development and support of this network infrastructure (e.g. AREN, CeNTIE and GrangeNet).

Education and research software markets exhibit two other important features in the role and importance of non-specialist developers and of open source/open access, freeware and shareware product. As noted elsewhere in this report, and demonstrated by the examples discussed below, the education sector is one of the more common non-ICT industry (i.e. non-specialist) sources of supply of telemediated software development and maintenance services.⁵ As is also demonstrated below, extensive use of open source, freeware and shareware is among the forces driving the education and research markets towards a services based business model.

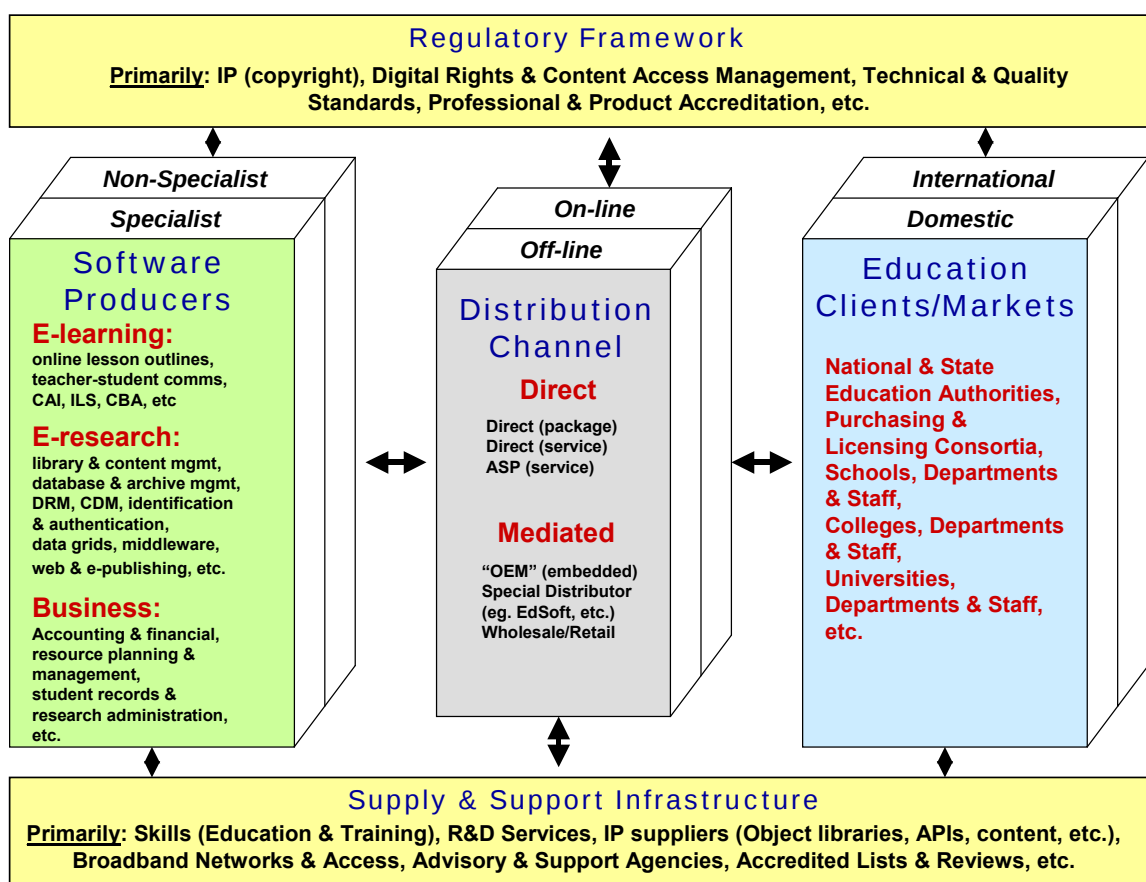


Figure 1. The education software product system

Source: CSES Analysis.

The structure of the education software product system emphasises the importance of collaboration and accreditation, and of adherence to, and monitoring of developments in evolving standards. It also makes clear the importance of producer-client linkages in innovation and development—where the clients are the lead players and, to a lesser extent, end users (i.e. teachers/researchers) and their employing institutions. It is also important to note that in such areas as e-learning the system is primarily about services, with software product ‘distribution’ being embedded in services and, to a lesser extent, content. Specialist educational software distributors tend to focus on special purchasing factors (e.g. tax free status), rather than specialist software.

Education expenditures

Education covers a wide range of activities, and is a large and growing sector. In general, higher income countries spend more per student than lower income countries. For primary education, Denmark, the US, Switzerland, Austria, and Norway spent

USD 6500 to USD 7000 per student during 2000, while at the secondary level, Switzerland, the US, Austria and Norway spent more than USD 8000 per student. The US, Switzerland, Canada and Sweden spent USD 15 000 to USD 20 000 per student in higher education.

Table 2. Public and private education expenditures per student, by level of education and country, 2000 (USDm)

	<i>Primary</i>	<i>Secondary</i>	<i>Higher education</i>
	<i>2000</i>	<i>2000</i>	<i>2000</i>
Australia	4,967	6,894	12,854
Austria	6,560	8,578	10,851
Belgium	4,310	6,889	10,771
Canada ¹	..	5,947	14,983
Czech Republic	1,827	3,239	5,431
Denmark	7,074	7,726	11,981
Finland	4,317	6,094	8,244
France	4,486	7,636	8,373
Germany	4,198	6,826	10,898
Greece ²	3,318	3,859	3,402
Hungary ²	2,245	2,446	7,024
Iceland ²	5,854	6,518	7,994
Ireland	3,385	4,638	11,083
Italy ²	5,973	7,218	8,065
Japan	5,507	6,266	10,914
Korea	3,155	4,069	6,118
Luxembourg	..	..	..
Mexico	1,291	1,615	4,688
Netherlands	4,325	5,912	11,934
New Zealand	..	..	..
Norway ²	6,550	8,476	13,353
Poland ²	2,105	..	3,222
Portugal	3,672	5,349	4,766
Slovak Republic	1,308	1,927	4,949
Spain	3,941	5,185	6,666
Sweden	6,336	6,339	15,097
Switzerland ²	6,631	9,780	18,450
Turkey ²	..	..	4,121
United Kingdom	3,877	5,991	9,657
United States	6,995	8,855	20,358

Notes: 1 Includes primary education. 2 Public institutions only.
Data adjusted to USD using purchasing-power-parity.
Source: OECD (2002) *Education at a glance 2003*, OECD, Paris.

A comparison of public direct expenditures on education as a percentage of gross domestic product (GDP) in OECD countries shows that national investment in

education in 2000 ranged from 3.5% in Turkey to 8.4% in Denmark, with an average public investment in education of 5.2% of GDP across the OECD countries.

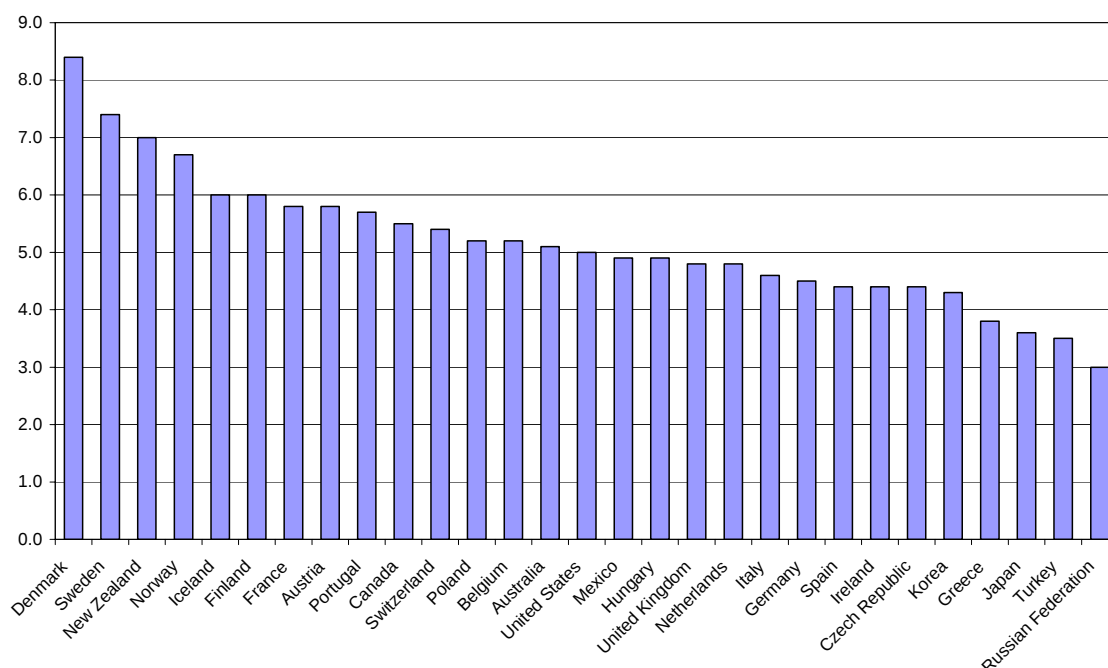


Figure 2. Public expenditure on education as a share of GDP, 2000 (per cent)

Source: OECD (2002) *Education at a Glance 2003*, OECD, Paris. CSES Analysis.

Australia has a well-developed education system with participation rates and secondary school completion rates among the highest in the world. Total expenditure on education in Australia in 2000–01 was \$40 billion, with government expenditure of \$29.6 billion and private expenditure of \$10.3 billion. Total education expenditure accounted for 5.9% of gross domestic product (GDP), with government expenditure accounting for 4.4% of GDP and private education expenditure comprising a further 1.5% of GDP.⁶

In 2004, there were 9615 schools in Australia, of which 72 per cent were government schools. There were 3.3 million full-time school students, and 26 438 part-time students. Vocational education and training is provided by a variety of organisations, including public institutes of technical and further education (TAFE), community based providers, private providers, and some secondary schools. In 2001, there were 87 government institutions (such as TAFEs and other government providers) delivering VET programs in 1322 locations. Government funded VET programs were also provided by 985 community education providers. Between 1991 and 2001, the number of VET students increased by 78%, from 985 900 to 1 756 800.⁷

Higher education in Australia is provided by 47 major institutions. There are also approximately 90 recognised private providers. These latter are estimated to be responsible for as much as 10% of total higher education student load. Of the 45 major

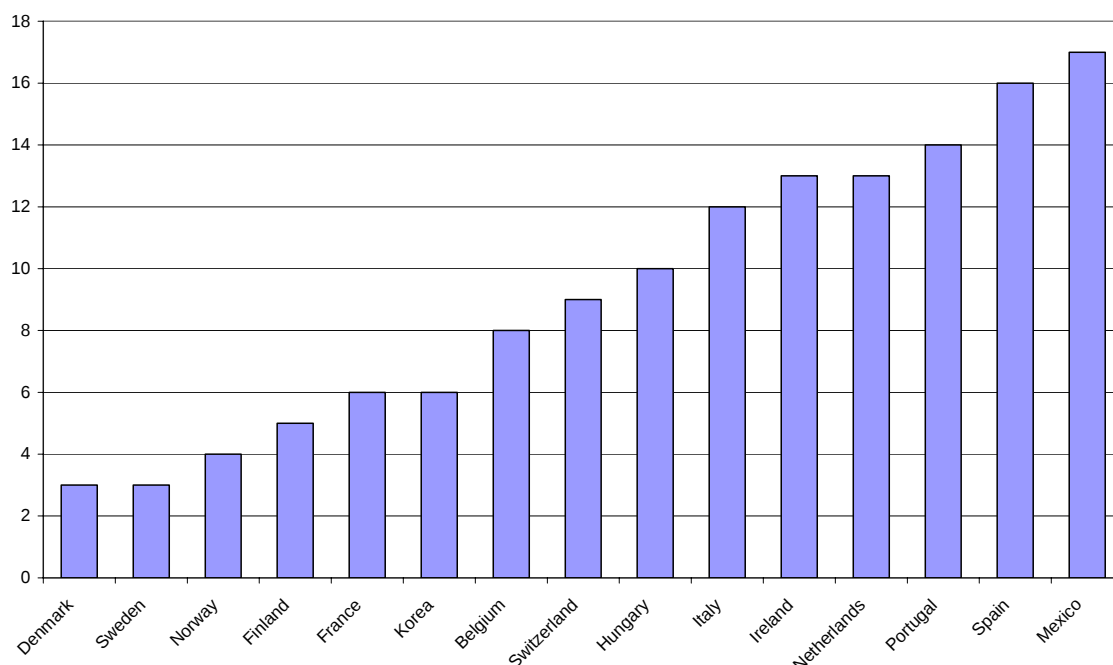
higher education institutions reporting to the Commonwealth Government, seven had more than 30,000 students in 2001, with a further five having between 25 000 and 30 000. The total number of higher education students in Australia increased from 31 700 in 1951 to 614 100 in 2001.⁸

The education software market

E-learning, the provision of training electronically, is a significant vertical application market. It includes online learning, web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning. OECD estimates have suggested rapidly increasing ICT expenditures in primary, secondary and tertiary education, with total annual expenditures on around USD 16 billion across OECD countries in the late 1990s—mostly on hardware and networks. This represented a relatively modest 1% to 2% of total education spending.⁹

Computer and Internet use in schools has increased rapidly, with almost all educational institutions now connected to the Internet and the ratio of students to computers falling rapidly in the most developed countries. In 2002, the student: computer ratio in NSW schools was 6:1, comparable to leading OECD countries.¹⁰ There is information on the rollout of ICT to schools, but it can be difficult to find information on its composition or the use of these technologies for learning. One source, found that in the four weeks prior to their 2003 survey, 84% of students in the European Union (EU) had used a PC and 45% had used e-learning (either online or offline).¹¹

Figure 3. Ratio of students to computers in schools, 2001



Source: OECD (2003) *Education at a glance 2003*, OECD, Paris.

Private expenditure on training and skills upgrading is also significant, with companies allocating around 2% of their payroll to training workers at the end of the 1990s.¹² Estimates of the e-learning component vary widely, with forecasts for e-learning market growth now lower than the overenthusiastic forecasts of the late 1990s.¹³ Forrester Research claimed to be conservative when predicting that the US corporate e-learning market would grow from USD 5 billion in 2003 to USD 6 billion in 2004, and USD 7.5 billion in 2005.¹⁴ IDC suggested that the market for corporate e-learning would reach between USD 10 and USD 20 billion worldwide by 2007,¹⁵ while eMarketer put worldwide (public and private) e-learning expenditures at USD 18 billion in 2001.¹⁶ The Australian e-learning market was estimated to be worth some \$150 million in 2001, with annual growth rates then projected to exceed 20%.¹⁷ IDC suggested that the e-learning market in the Asia-Pacific region would have been worth \$453 million in 2004, with growth being driven by Australia.¹⁸ Focusing on work-related training, one 2003 survey found that in Europe almost 41% of the labour force had participated in work-related training in the four weeks prior to the survey, with 14.5% of the base labour force, or 35.5% of those who had undertaken training, using e-learning.¹⁹

Box 1. Use of ICT in UK further education, 2004

One recent UK survey demonstrates the level and nature of use of ICT in post-secondary education.

In mid 2004, there were an estimated 320 000 computers in the 395 UK colleges, double the number found in 1999. All colleges in the UK are connected to Internet via a minimum 2Mbps link. The median number of fulltime equivalent students to an Internet enabled computer was 4.5, down from 21 in 1999.

Eighty-six per cent of colleges were using intranets as a learning platform, and 94% were using shared areas on the LAN. Commercial virtual learning environments (VLEs) were being used in 70% of UK colleges.

E-learning materials were used mainly at the discretion of the teacher (56% of colleges). College-wide and departmental direction was less common. The Internet was the most common source of e-learning materials (97% of colleges). Eighty-four per cent reported using National Learning Network (NLN) materials.

ICT is more widely used for learning support and independent learning than for classroom delivery. Nevertheless, in 20% to 25% of colleges ICT was seen as an integral classroom tool. 66% of colleges delivered 'learn direct' courses, and 50% supported remote learning.

Online assessment was little used in most colleges, with only 2% suggesting that it was a widespread activity. However, it was being used in more than 50% of colleges by isolated enthusiasts.

Source: Becta (2004) *ICT and e-learning in further education: embedded technology, evolving practice*, A Report to the Learning and Skills Council, Becta, Coventry.

In the United Kingdom, education sector spending on ICT was estimated at GBP 1.6 billion during 2002, and to have increased by more than 30% during the year.

An estimated GBP 719 million was spent by schools, GBP 595 million by higher education and GBP 265 million by further education.²⁰ These numbers exclude content.

There is no comprehensive data on education ICT spending in Australia, but a similar level of spending by educational institutions to that in the UK would imply a market of just over AUD 1 billion in 2002, of which almost AUD 600 million would come from schools and more than AUD 500 million from higher education. Most local estimates suggest similar figures, with ICT expenditure by public schools throughout Australia reported to have been of the order of AUD 500 million in 2003.²¹

IDC estimates expenditure on ‘contestable’ software (i.e. excluding operating systems, platforms and standard desktop systems) by the Australian education sector at AUD 73 million in 2004, rising to AUD 83 million in 2005.²² These figures are much lower than some industry estimates, which suggest something closer to AUD 350-400 million.²³ This variation may reflect differences in definition, the extent of non-specialist and non-market activity, and the prevalence of service and equipment ‘embedded’ software.

Box 2. Educational technology fact sheet: United States

In US schools, 99% of schools and 92% of classrooms are connected to the Internet. 94% are connected to broadband Internet access, including 95% of the lowest-income schools.

In 2002, 8% of public schools lent laptop computers to students. Schools in rural areas (11%) were more likely than city schools (6%) and urban fringe schools (6%) to lend laptops.

In 2002, 7% of public schools provided a handheld computer to students or teachers. Schools in rural areas (10%) were more likely than city schools (5%) and urban fringe schools (6%) to provide them.

Twenty-three per cent of K-12 schools are using wireless.

56% of two- and four-year degree-granting institutions offer distance education courses, with 90% of public institutions offering distance education courses.

Twelve states have established online high school programs and five others are developing them, 25 states allow for the creation of so-called cyber charter schools, and 32 states have e-learning initiatives under way.

40 000 to 50 000 K-12 students will have enrolled in an online course by the end of the 2001–02 school year.

More than \$700 million is dedicated for the use of technology to improve student achievement through the Enhancing Education Through Technology initiative. Schools must use at least 25% of these funds for professional development.

\$2.25 billion in the federal E-rate Program supports discounts on telecommunications services, Internet access, and networking for schools and libraries.

Every program in No Child Left Behind is an opportunity for technology funding since technology can be used to help accomplish specific program goals. Just as we ask schools to integrate technology with the curriculum—No Child Left Behind integrates technology into specific content area programs.

Source: US Department of Education, <http://www.ed.gov>

Indicatively, during 2003–04, the NSW Department of Education and Training allocated:

- \$544 million over four years for the Technology for Learning (T4L) program to provide public schools with 100 000 state-of-the-art computers as well as support from 129 permanently employed technical support staff;
- more than \$156 million for the progressive upgrade of network bandwidth in schools and TAFE NSW over four years to support expanded Internet services; and
- \$77.5 million for e-learning accounts for TAFE NSW and school students and staff.²⁴

A 2004 audit report revealed that spending on computers for schools had increased from \$37.6 million in 2002 to \$44.2 million in 2004, although total IT spending fell from \$149 million to \$122 million, due to savings in communications, staff and software costs.²⁵ Similarly, the Victorian Government recently allocated more than \$96 million over four years to the SmartONE initiative to bring broadband to schools,²⁶ and has committed a further \$21 million for new computers for every government school in Victoria. The total funding will provide more than 19 000 new computers and other IT equipment such as personal digital assistants and laptop computers in classrooms across Victoria.²⁷ How much of such ICT expenditures relates to software is unknown.²⁸

Box 3. National report on schooling in Australia, 2000

In 2000, nearly 85% of Australian students had access to computers at home almost every day compared with 63% of their counterparts in other OECD countries. Nine per cent of Australian students never had access to computers at home, compared with 23% of the OECD population. Forty-three per cent of Australia's students used a computer almost every day at home compared to the OECD average of 38%.

Australian students who used a computer at home almost every day obtained a mean score of 539 on the PISA (OECD Programme for Producing Indicators on Student Achievement on a Regular Basis) reading assessment and the mean of the OECD students who used a computer almost every day was 519. Each of these scores was above the overall OECD mean for reading literacy (500).

Forty-nine per cent of Australia's students used a computer at least a few times a week at school, compared to the OECD average of 36%. The mean reading literacy score for students who used a computer almost every day at school was 533 (above the Australian mean of 528), compared to the OECD mean of 496.

Just over 31% of Australian students accessed the Internet almost every day, and a further 32% accessed it a few times a week. This compares to the OECD country averages which show that 24% of students accessed the Internet almost every day, and a further 24% accessed it a few times a week.

Source: MCEETY (2002) *National report on schooling in Australia*, Canberra.
(http://cms.curriculum.edu.au/anr2002/ch9_student.htm).

Box 4. Children's use of computers and Internet in Australia

Computer use

In the 12 months to April 2003 most (95%) children aged 5–14 years used a computer during or outside of school hours. For these children (2 517 500) it is estimated that: 2 369 200 (94%) used a computer at school; 2 165 300 (86%) used a computer at home; 1 050 800 (42%) used a computer at someone else's home; and 303 300 (12%) used a computer at a public library. Computer usage increased with age from 82% for 5 year olds to 99% for children aged 11 years and older.

Of the children who used a computer at home, most did so more than once a week (74% or 1 603 400). Some 19% of children did so every day (416 500). The activities for which these children used the home computer varied with their age. For the 5–8 year olds, 91% used the computer to play games (685 300), 70% used it for educational purposes (525 000) and 25% used it to email or do other Internet based activities (187 400). For 12–14 year olds, 94% used the computer for educational purposes (680 000), 76% used it for playing games (546 600) and 69% for emailing and other Internet based activities (499 000).

Internet use

In the 12 months to April 2003, the Internet was accessed by 1 693 300 children during or outside of school hours. This was 64% of all children, aged 5–14 years, and 67% of children who used computers. The proportion of females who accessed the Internet was slightly higher (66%) than the proportion of males who accessed the Internet (62%). Across the age groups, 21% of children aged 5 years used the Internet, compared with 90% of 14 year olds.

For those children who accessed the Internet, it is estimated that: 1 341 600 (79%) accessed the Internet at home; 1 181 900 (70%) accessed the Internet at school; 412 400 (24%) accessed the Internet at someone else's home; 117 000 (7%) accessed the Internet at a public library; and 57 200 (3%) accessed the Internet at other places (e.g. Internet cafes).

Use of the Internet varied across the age groups.

- For 5–8 year olds, popular uses of the Internet at home were to play games (68% or 204 200), school or educational tasks (65% or 194 600), browsing for leisure (24% or 71 200), and using email or chat rooms (23% or 68 500).
- For 9–11 year olds, the Internet was used at home for school or educational tasks (89% or 409 000), playing games (60% or 275 300), using email or chat rooms (40% or 184 100), and browsing for leisure (39% or 181 100).
- For 12–14 year olds, popular uses of the Internet at home were for school or educational tasks (94% or 545 700), using email or chat rooms (67% or 390 700), playing games (52% or 300 200) and browsing for leisure (50% or 291 000).
- Over half (61%) of the children who accessed the Internet at home did so more than once a week (824 800) and some (14% or 193 400) did so every day. The majority (70%) of children who accessed the Internet at home everyday were 12–14 year olds, followed by 9–11 year olds (23%), and 5–8 year olds (7%).

Source: ABS (2004) *Children's Participation in Cultural and Leisure Activities, Australia*, Cat No 4901.0, Canberra.

Looking at the market for online education and research related content, Simba estimates put the global scientific publishing market at USD 11 billion in 2003, up by 3.2% on 2002.²⁹ There is no single source of information on the Australian educational content market, but it is indicative that Australian university libraries spent around AUD 175 million on content during 2003.³⁰ It is likely that schools and colleges, public libraries and a range of other sectors (e.g. engineering, law, health and medical, consulting and professional services) spent at least as much again.

Education software verticals: e-learning, e-research and business administration

As noted, software, related content (multimedia) and services supplied to education sector users are of three main types.

- *Business management*—e.g. accounting, financial, resource planning and management, student records and research administration
- *Teaching and learning tools (e-learning)*—e.g. online lesson outlines, teacher-student communication, computer assisted instruction, integrated learning systems, computer based assessment tools, etc.
- *Research and information infrastructure (e-research)*—e.g. library and content management, database and archive management, copyright and digital rights management, communications, access, identification and authentication systems, data grids, middleware, specialist analysis systems, web publishing and e-publishing

E-learning and e-research are specialist vertical applications markets. Within each, there are suppliers of software, content and value-added services, and network and related infrastructure. In addition to these, business and administration systems are an important part of the education vertical market.

E-learning

E-learning exploits interactive technologies and communication systems to improve the learning experience. It has the potential to transform teaching and learning, raise standards and widen participation in lifelong learning.³¹ E-learning supports the following.

- *Individualised learning*—e-learning can provide an individualised learning experience for all learners, including those who are disadvantaged, disabled, exceptionally gifted, have special curriculum or learning needs, or who are remote or away from their usual organisation base.
- *Personalised learning*—e-learning can provide personalised information, advice, and guidance services help learners find the course they need, with seamless transition to the next stage of their learning, including online application or enrolment and an electronic portfolio of their learning to take with them.

Box 5. Scope of ICT in Australian universities

Administrative computing—ICT required to develop, maintain and support systems associated with: student administration (e.g. admission, enrolment, timetables, HECS, administration, graduation, alumni); financial administration (e.g. accounts payable, receivable, general ledger, debtors, purchasing); human resources administration (e.g. staff records, payroll); research management; corporate web site; university web portal.

Academic and research computing—ICT associated with discipline based activities, including: support for academic staff system or programming development and maintenance where this is discipline based and associated with teaching or research; supporting research consultancy where IT infrastructure is involved; support for the academic components of CRCs or other joint research arrangements.

Learning and teaching systems—ICT required to develop, maintain and support those systems associated with the delivery of teaching and learning through the use of IT, including: library cataloguing system; learning management systems (e.g. WebCT, Blackboard, Lotus Learning Space, in-house teaching and learning systems); audiovisual technology support for teaching spaces; digital repositories.

Student computing—refers to the development, support and maintenance of the desktop environment for student access to systems, including: common-use student workstations, laptops, printers, scanners and other peripheral equipment available for use by all students; school or faculty student workstations, laptops, printers, scanners and other peripheral equipment available for exclusive use by students of specific schools or faculties; specialist hardware and software for student use where the facilities would be used by for very specific subjects; workstations for student use that are not laboratory based (i.e. workstations that are funded and supported by the university and which may be on-campus or off-campus in facilities associated with the university (e.g. student residences).

Support services—refers to the structured facilities for dealing with user issues, including: face-to-face support (e.g. walk-in or roving support for staff and students); non face-to-face support (e.g. telephone, email, electronic noticeboards, electronic chat, remote desktop management); development, support and maintenance of a knowledge base for users; development, support and maintenance of formal help and service desk management systems.

Communication and collaborative technologies—refers to a wide range of systems and tools, including electronic mail, electronic messaging, corporate videoconferencing, desktop videoconferencing, access grids, mobile technologies (i.e. handheld computers) and identity management.

IT security—ICT for IT security, including: security incident response; monitoring, policing and prevention of security issues on systems and networks; developing guidelines and procedures for staff and students.

Network infrastructure—ICT required for the transmission of voice, data and video within and outside the institution, including: campus networks including cabling and plant; wide area networks including Internet connections; voice services including PABX and handsets; mobile phones.

Data centre and operations—the ICT required to develop, maintain and support services which require specialised facilities, including servers, storage area networking, backup and monitoring servers, and provision for a 'hot' site.

Source: Council of Australian University Directors of Information Technology CAUDIT, (www.caudit.edu.au).

- Collaborative learning—e-learning offers a wide range of online environments from school, college, home or work, to work with and learn from other individuals or groups of learners as well as tutors, and develop the cognitive and social skills of communicating and collaborating.
- Tools for teachers and learners to innovate—e-learning offers a wide range of design tools to enable teachers and learners to be innovative, creating and sharing ideas, or customising digital learning resources for their own use.
- Virtual learning worlds—where learners can take part in active and creative learning with others through simulations, role play, remote control of real-world tools and devices, online master classes, or collaboration with other schools or organisations.
- Flexible study—e-learning can offer flexible learning on demand, anytime or anywhere, blending traditional and innovative methods to meet learners' needs on or off campus, at home and school, at work or in a community leisure venue.
- Online communities of practice—the Internet can bring learners, teachers, specialist communities, experts, practitioners and interest groups together to share ideas and good practice, contributing to new knowledge and learning.
- Quality at scale—e-learning achieves economy of scale through wide access to digital resources and information systems, combined with quality through shared tools and resources, and common standards of design and effectiveness.³²

As a vertical application, e-learning has both public and private sector markets. There are significant opportunities in the extension of e-learning throughout the primary, secondary and tertiary education system, and major opportunities in the development of e-learning in business and government life-long learning, skilling and training.

E-learning involves three main areas of software industry opportunity:

- infrastructure—connectivity, bandwidth and network support;
- content—education and research related content, such as online publications; and
- tools—for the use and management of e-learning.

The infrastructure can in some cases (e.g. higher education) be shared with other uses (e.g. e-research, discussed below). Nevertheless, infrastructure support for schools and community lifelong learning is often specific to e-learning activities. E-learning content and tools are more specialised than other educational applications and are provided by a range of local and multinational suppliers, which may be either specialists in educational systems or non-specialist suppliers. There is also substantial in-house production.

E-research

ICT is fundamentally changing research practices, bringing new information needs.³³ The US National Science Board (2002) noted that IT has provided new tools for the simulation and modelling of complex natural, social, and engineering systems. It has enabled new methods of data collection and has made possible the creation of massive, complex, and shared data sets. It has changed the way scientific knowledge is stored and communicated. IT has facilitated the sharing of computational resources and scientific instruments among scientists and engineers in different locations and has aided communication and collaboration among large groups of researchers.³⁴

The impacts of ICT on research include the following.

- It enables communication among scientists—encouraging collaboration, enlarging and improving teams, with collaboration fundamental to interdisciplinary research and thought to improve researcher productivity and quality.
- It enables greater access to information of all kinds—published and unpublished, text and non-text, which is particularly important in relation to accessing large shared datasets (e.g. the Human Genome Project).
- It provides access to high-performance computing—fundamentally changing research in respect to modelling, simulation and visualisation, with new ways of ‘seeing’ hitherto hidden and inaccessible structures and processes now possible (e.g. medical imaging and protein folding).
- It is revolutionising scientific instruments, both by enhancing specific capabilities and making instruments more flexible to use.
- It is enabling access to remote instruments, including large facilities and shared instruments, as well as remote sensing and data collection.
- It enables easier handling and marshalling of information, thereby extending the capabilities of researchers to synthesise, process and create knowledge.
- It is enabling a greater variety of enhanced research publication, dissemination and communication mechanisms.

The concept of the grid has emerged as researchers harness high capacity networks, powerful computers, mass data storage systems, virtual and augmented reality and videoconferencing facilities, and large-scale instruments. Network technologies and services are now regarded as essential to support distributed research communities around the world. Examples of grid technologies include:

- computing grids—providing access to distributed computers to allow applications to be executed across multiple computing systems;
- data grids—allowing high-speed interactive access to large-scale distributed datasets (e.g. in astronomy and bioinformatics);

- instrument grids—allowing access to large-scale instruments (e.g. electron microscopes) so that experiments can be conducted remotely;
- collaborative working environments (collaboratories)—connecting sophisticated videoconferencing and shared systems facilities to allow group-to-group communication and interaction; and
- cooperative visualisation environments—connecting visualisation and virtual reality facilities (visualisation grids) to allow researchers at different locations to simultaneously examine a computer-generated model of an engineered product.³⁵

At the same time, there is extensive and increasing use of online content in scientific and scholarly research communities. Education for Change *et al* (2002) found that electronic journals and other sources were regarded as essential by 53% of UK based researchers, electronic pre-print archives by 30% and computerised datasets by 25%.³⁶ Similarly, Friedlander (2002) found that researchers in the US used multiple sources, with more than 80% of biological and physical sciences researchers using electronic journals, as did around 75% of researchers across the sample.³⁷

Healy (2002) found that 66% of those in law used electronic resources for research all or most of the time, as did 56% of those in business and management, 48% of those in biological sciences and engineering, 46% of those in physical sciences, 37% of those in social sciences and 25% of those in arts and humanities.³⁸ Online access to both data and publications is now the norm in higher education and research communities.

This high and rapidly increasing use of digital content has led to fundamental changes in the dissemination of scientific and technical knowledge. The US National Research Council (2001, p5) noted that:

The rapidly expanding availability of primary sources of data in digital form may be shifting the balance of research away from working with secondary sources such as scholarly publications. Researchers today struggle to extract meaning from these masses of data, because our techniques of searching, analysing, interpreting, and certifying information remain primitive. New automated systems, and perhaps new intermediary institutions for searching and authenticating information, will develop to provide these services, much as libraries and scholarly publications served these roles in the past.³⁹

There is a proliferation of data, new forms of research output and reporting, and new modes of presentation and analysis. In addition to journal articles and research monographs, researchers are now producing a wide range of ‘born-digital’ objects as an integral part of their work. These include:

- collections of observations and data, some of which are the result of automated observation and data collection (e.g. from the Hubble Telescope);
- data-rich results, which take the form of data that others can use (e.g. gene sequences);

- algorithms and elements of computer software that can be used by others (e.g. open source and object libraries); and
- a range of digital compositions (e.g. audio, video, still images, maps.).

The UK's Joint Information Systems Committee (2002) suggested that: 'multimedia and distributed computing grids are developments that extend the processes of scholarly communication, while at the same time presenting considerable management challenges'.⁴⁰ New digital object access management systems will be required, and there will be increasing demand for collaborative research support applications and research support systems that enable researchers to bring together the increasingly disparate digital objects used in research in such a way as to facilitate enhanced integrated analysis.⁴¹

The challenge is to use ICT to provide an integrated and sustainable science communication system that encompasses all forms of research output and makes it easy for researchers to communicate their results and for users to access and exploit these outputs.⁴²

As a vertical application, e-research has both public and private sector markets. There are significant opportunities in the facilitation and support of e-research in higher education and public research organisations as well as in R&D intensive industries (e.g. pharmaceuticals and biotechnology, electronics, automotive.). E-research involves four main areas of software industry opportunity:

- infrastructure—connectivity, bandwidth and network support;
- access systems—for the facilitation and management of access to information resources;
- middleware—for the support and management of access to and preservation of digital research objects of all kinds; and
- tools—for analytical manipulation and management of e-research content.

The infrastructure can in some cases (e.g. higher education) be shared with other uses (e.g. e-learning, discussed above). Nevertheless, infrastructure support for such things as large-scale collaborative research projects, automated data collection and the development of institutional repositories is specific to e-research. Some of these areas have already attracted major investments and the attention of leading suppliers (e.g. IBM Life Sciences, Hitachi Data Systems).

Business administration and management

Schools, universities and private education service providers are often large-scale operations, involving the same sorts of accounting and financial management, human resources management, purchasing and asset control needs as large organisations in any industry. There are also demands for student management systems and secure student records management. Many of the software needs in these vertical market areas are met by systems and suppliers that do not specialise in or focus on the educational market vertical, but supply a range of vertical markets.

Box 6. Hardcat at Edith Cowan University

Edith Cowan University (ECU), is located in Western Australia, has international enrolments exceeding 3000 with students originating from more than 80 countries. ECU's origins go back to 1902 when it began as a teaching college. Today it is Western Australia's second largest university, with almost 23 000 students.

While its assets over \$5000 are managed via the University's ERP system, but assets under this value were managed by the individual faculties or business service areas in varying spreadsheet based formats. The result was that asset registers did not always exist, and where they did exist, were often incomplete or their accuracy doubtful.

The purchase of a proprietary, barcode based asset management system, Hardcat, has enabled a full inventory of assets to be obtained. The database now controls in excess of 25 000 asset records, spread across five campuses, a possible 7900 room locations, 1000 plus staff members and incorporating 4700 product types. The complete range of the university's assets have been captured including, computing and office equipment, network and IT infrastructure assets, laboratory and scientific instruments, multimedia equipment, musical instruments, sports equipment and even the anatomy models and human specimens in the University's anatomy museum.

Source: Hardcat <http://www.hardcat.com/>.

Business and administration systems are among the largest expenditure items within the education vertical market, as current contracts in NSW, South Australia, Tasmania and Queensland demonstrate. NSW's Oasis schools system cost some \$32 million to develop 20 years ago,⁴³ and Melbourne's RMIT was reported to have spent \$47 million on its somewhat problematic Peoplesoft implementation.⁴⁴ During 2001, Queensland University of Technology spend \$37 million.⁴⁵

As these examples suggest, perhaps the largest opportunity in education lies not in vertical applications (the primary topic of this chapter), but in tailoring horizontal applications into vertical markets (e.g. ERP, identified as an opportunity in most of the market verticals studied). Education is a significant vertical market for software, but opportunities in vertical software applications (e.g. e-learning) may be somewhat less significant than they might seem at first sight.

The education vertical market characteristics

There is increasing interest in using ICT to both increase productivity in the education sector and to extend and enhance education and learning practices. As a result, there has been rapidly increasing demand for ICT equipment, software and content in the education sector. *Over time, demand is shifting from an earlier emphasis on equipment and networks towards greater emphasis on software applications, tools and content.*

The nature of the market demand is also changing, with customers increasingly demanding networked rather than local media delivery, unrestricted site licensing rather than machine licensing, and a focus on long-term service and support rather than one-off sales based on price alone.⁴⁶ Indeed, the latter is a key characteristic. *Education is increasingly a services market.*

The educational software market exhibits a number of key features that shape development. *There is a need to collaborate and partner with other education market stakeholders* in the development of specific vertical market products (e.g. e-learning), if they are to be successful in the marketplace.⁴⁷ What is emerging is a series of partnerships and alliances between different types of organisations, which are combining their resources to facilitate delivery of education over networks. For developers of software and course-related content, partnering with education specialists and practitioners is an essential part of product development (perhaps the principal innovation linkage).⁴⁸

There are significant differences in procurement practices between national education markets. In some countries educational software and content purchasing is subject to centralised approval at the state and sometimes even national levels (e.g. Canada, Sweden, Greece), while in other countries there is much greater autonomy, with purchasing decisions left to particular schools or universities and, sometimes, even individual staff members (e.g. Belgium, France, Denmark, UK, Netherlands).⁴⁹ Would-be suppliers need to adopt very different marketing, delivery and service strategies in order to operate in these different markets.

There are also significant cultural and regulatory differences in both national and international markets. Language is an obvious factor, including the support for minority languages (e.g. Inuit in Canada). There must also be relevant local and national examples in content in order to engage local students and ensure that local and national sensibilities in such issues as historical interpretation of key events are taken into account. Deep local cultural and traditional knowledge is often required. In the corporate training sector, regulatory change is often a major driver of training activity, with organisations seeking to train their staff in order to meet compliance criteria. Again, deep local knowledge is often required—in this case of regulations and professional and trade qualification standards—making operation in foreign markets difficult.

Concern over quality and relevance of tools and content is leading to increasingly centralised accreditation and the publication of approved supplier lists, making marketing to and liaising with accreditation authorities an essential step in the development process. There are many examples. Digital content for Californian schools has been considered against criteria developed by the California Instructional Technology Clearinghouse since the 1980s, the French Ministry of Education has supported expert evaluation of materials, with a list of approved materials circulated throughout the education system, and in Germany and Austria there has been a centralised software documentation information system (SODIS).

Major initiatives such as the UK's National Grid for Learning (<http://www.ngfl.gov.uk/>) and similar developments in other countries (e.g. EdNA: <http://www.edna.edu.au/>), provide a more or less one-stop source of information on and access to educational materials for targeted education sectors. Consequently, accreditation authorities are becoming increasingly important gatekeepers.

Table 3. Key market characteristics by activity area

<i>Activity area</i>	<i>Key characteristic / demand</i>
Bandwidth & access services	Purchasing consortia
Middleware & systems management	Open standards & interoperability
Educational & research content	Open access, IPRs, DRM, quality & technical standards, interoperability, culture/localisation
Analytical and pedagogical tools	Collaboration & partnerships

Source: CIIER Analysis.

International standards initiatives may lead to the creation of market blocs. Becta (British Educational Communications and Technology Agency) noted that the development of infrastructure, software and protocols that enable digital connectivity had been piecemeal, with competition between a range of commercial providers limiting the development of common standards. Becta noted that a demand had now risen for improved interoperability of systems.

This includes a demand for transparent connectivity between government systems with e-government development and educational networks, such as the UK's National Learning Network, and within the education system itself.⁵⁰ Fostering interoperability is also an objective of higher education bodies working towards an 'international information environment'.

The British Joint Information Systems Committee's (JISC) vision is for a single, worldwide information environment, which it sees as a necessary goal in providing most of the information needed by scholars and researchers for their day-to-day work. JISC recognises that the vision will be difficult to achieve, with the barriers such as the lack of universally accepted protocols and methods of cataloguing, indexing, digitising, and preserving information to guarantee conformity and interoperability remaining to be addressed.

Nevertheless, JISC sees the need to work, in partnership with other organisations, towards achieving the vision of an international information environment.⁵¹ Metadata standards, such as the shareable content object reference model (SCORM),⁵² which enables the tagging and sharing of course-content objects, are an example of developments.

There is increasing consortia purchasing and national site licensing (e.g. the Canadian National Site License, and Australia's own consortia purchasing of access to research publications through the Council of Australian University Librarians). Such initiatives are widespread and are likely to increase the importance of market blocs and consortia, effectively reducing the number of customers and making marketing to them the key to market entry and access.

Open source software and open access are also becoming important in the sector, creating increasing uncertainty in the development of sustainable business models for educational software and content providers. There are many initiatives being undertaken by a wide range of organisations seeking to promote the use of open source software and open access to content in the education and research sectors. These range from school oriented initiatives (e.g. SchoolForge, the Open Source Education Foundation)⁵³ to those focusing on research data (e.g. OECD Declaration on Access to Digital

Research Data from Public Funding)⁵⁴ and open access (e.g. The Bethesda Statement on Open Access Publishing, and The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities).⁵⁵

Open source and open access movements appear to be gaining momentum, and may present a major challenge in the education, e-learning and e-research markets.⁵⁶ Many institutions, agencies and governments are seriously evaluating open source / open access alternatives, with Becta recently reporting that a study of open source software in UK schools demonstrated that, although the implementation of OSS in schools needs careful planning and support, the use of OSS can offer a cost-effective alternative to proprietary software.⁵⁷

A major OECD study of e-learning in higher education found that the development of in-house software and use of open source software are noteworthy trends in tertiary education.⁵⁸ In New Zealand, the Education Ministry recently signed an 18-month agreement with Novell to provide open source software to schools.⁵⁹ Open source systems (e.g. Moodle moodle.org) are gaining significant user bases, and there is ever increasing pressure for open access to the findings of publicly funded research.

Box 7. The UK experience

Infrastructure

Over recent years the government has invested heavily in ICT, in every phase of education. Every university and college has broadband access, with an average of one computer for every three students. Every school is connected to the Internet and will have broadband by 2006. Already there is more than one computer for every five secondary school students and more than one for every eight primary school pupils. Ninety-two per cent of public libraries offer Internet access. And this hardware is backed by a growing range of interactive resources and improved workforce training.

E-learning

- One in four primary school lessons uses technology, and over half of all secondary pupils have their own school based email account to help them with their studies.
- Six million people use college and university networks.
- There are now more than 7000 UK online and learndirect centres, including 3000 public libraries.
- Ninety-nine per cent of UK households are within 10km of a learndirect or UK online centre, and 89% are within walking distance (3km).

Impact

These inputs have made a measurable difference. The British Educational Communications and Technology Agency (Becta) reports more effective management of ICT, with 76% of schools and colleges making progress in using ICT throughout their work. It also points to growing teacher confidence and competence, and provides evidence that ICT is helping to improve students' results. Better access and teacher confidence are also changing how lessons are taught. Since 2002, for example, the proportion of secondary maths lessons based on ICT has risen from 24 to 41%. The Office for Standards in Education (Ofsted) reported in 2004 that primary school lessons involving ICT were better taught than other lessons.

Source: Department for Education & Skills (2005) *Harnessing Technology: Transforming Learning and Children's Services*, DfES, Nottingham (www.dfes.gov.uk/publications/e-strategy).

e-Research covers a range of systems, tools and middleware that facilitate access to, manipulation and analysis of research data. There are both private and public sector players. Australian examples include Proteome Systems in the private sector and Distributed Systems Technology Centre (DSTC) in the public.

Proteome Systems has developed a suite of products for the acceleration and optimisation of proteomics based research, including integrated systems, advanced instruments, bioinformatics software and consumables.⁶⁰

Box 8. Proteome Systems

Proteome Systems began in early 1999, and was founded by Professor Keith Williams and a core team of scientists from the Macquarie University Centre for Analytical Biotechnology. During the 1990s, the founders made an important contribution to the revolution in proteomics, including: coining the word 'proteome' in 1994; establishing the world's first government-funded proteomics facility at Macquarie University, under the Australian Major National Research Facilities Program in 1995; co-authoring the first text on proteomics in 1997; and developing commercial proteomics technologies.

Proteome Systems Limited comprises Proteome Systems Technology and Proteome Systems Discovery. Proteome Systems Technology business develops, manufactures and commercialises innovative technology solutions comprising instruments, software and consumables that enable proteomics research. Proteome Systems Discovery business discovers protein biomarkers that have potential for use as diagnostics and therapeutic targets in the areas of respiratory disease, neurobiology and aging, cancer and infectious disease. PSL has research and development and manufacturing facilities in Sydney and in Boston.

Proteome seeks to commercialise diagnostics tools, for example, the market for a TB diagnostic tool is potentially worth \$1.8 billion and similar opportunities are driving current development work on treatments for lung infections and ovarian cancer.

Source: PMSEIC (2005) *Growing technology-based SMEs*, Final report March 2005, Canberra.

DSTC was established in 1992 as a centre of excellence in distributed systems technologies. It was supported by the Australian Government's Cooperative Research Centres Program, and a consortium of government, industry and university organisations. Among a range of 'products' targeting health, defence and other sectors, DSTC developed a MetaSuite for metadata management, which is a powerful solution toolset for creating and managing high quality Dublin Core-style metadata repositories. It is scalable, robust and can be tailored to meet specific needs of individual portals.

MetaSuite has been in use commercially since 1999 and has a proven track record in providing best-practice metadata management for complex information holdings.⁶¹ Unfortunately, despite playing a key role, the DSTC related CRC (CRC for Enterprise Distributed Systems Technology) was not funded in the most recent round of CRC funding and the organisation is being wound up.

There is also a range of public and semi-public initiatives that provide the underlying e-science infrastructure and grid computing capabilities in Australia, as there is in other developed countries. In Australia, these include the following.

- High-bandwidth communications networks, including the Australian Research and Education Network (AREN), the Centre for Networking Technologies for the Information Economy (CeNTIE), and the GRid And Next Generation Network (GrangeNet)
- Distributed high-performance computing and data storage capacities, including the Australian Partnership for Advanced Computing (APAC) and APAC partners

- A range of accessible data and information repositories, including recent projects under the Australian Research Information Infrastructure Committee (ARIIC)
- Accessible research instruments and facilities, including through the Major National Research Facilities program, and the ARC Linkage Infrastructure Equipment and Facilities program
- Agreed standards and coordinated middleware development— through the meta-access management (MAMS) project supported by ARIIC, the public key infrastructure project supported by DCITA, and GrangeNet⁶²

In addition, the Commonwealth Government has recently established an e-Research Coordinating Committee to act as an expert advisory group and suggest an e-research strategy that brings greater coordination to the many developments underway.⁶³

Public sector organisations also make a major contribution to e-research related software development.

At present, there are open source core middleware components made available by a number of international consortia, such as the UK Open Middleware Initiative Institute and the US National Middleware Initiative, which provide the basic functionalities of authentication, file transfers, and data access. Other components of middleware, such as workflow, scheduling, resource management and fault detection are less developed.⁶⁴

Private sector involvement tends to be focused upon content and some of the leading edge development in such areas as bioinformatics.

Box 9. Software from DSTC (Distributed Systems Technology Centre)

MetaSuite is DSTC's answer to metadata management. This Australian technology innovation is a powerful and complete point-solution toolset for creating and managing high-quality Dublin Core-style metadata repositories. It is scalable, robust and can be tailored to meet specific needs of individual portals. MetaSuite has been developed with a more rigorous metadata classification system than traditional approaches such as Google. This ensures that searches undertaken using MetaSuite are contextually richer, and provide better quality end results. MetaSuite has been in use commercially since 1999 and has a proven track record in providing best practice metadata management for complex information holdings.

Corba Services. DSTC offers a range of commercial quality implementations of OMG standard CORBA service specifications. These implementations are scalable, multi-threaded and federation capable.

uTest is a Java testing harness for use in automated or stand-alone testing.

Release 2.0 provides classes to create and run unit, integration and system test cases, logging output of individual and summary results. Multiple testing scenarios can be run through scripts and test properties files. New unit tests can be created by extending the classes provided. Tests can be data driven from testing data files. uTest includes documentation on effective testing strategy.

Subjective logic is a calculus for belief functions which is compatible with probability calculus and binary logic. Subjective logic was developed under DSTC's project on [trust management](#) in order to model networks of trust, but it can also be used for artificial reasoning in situations where decisions have to be made in an environment of partial ignorance.

Open Source XML Software Tools have been developed by DSTC's Titanium project team, and are already in use by companies around the world.

- JackSVG is a tool that builds self-contained scalable vector graphics slideshows from a user-supplied document containing XML markup. It is very flexible and includes support for user-written themes for generated slideshows.
- The XMLdbGUI is a Java GUI application that allows the user to view, manage, update and query the contents of any XML database that supports the XML:DB API.
- xs3p is an XSLT style sheet which allows you to generate detailed and attractive documentation from XML-schema documents. It requires a XSLT processor to function.

Piccola is a smartcard management library that allows users to manage applications on a multi-application capable smartcard. It aims to provide a management framework that allows users securely manage both the smartcard and applications that may reside on it in a vendor independent way. It primarily targets the global platform compliant cards. Piccola is created to investigate and challenge assumption and traditional smartcard deployment and business models in the industry. It aims to explore new scenarios, including innovative methods of card application management with portable devices and embedded systems.

Source: DSTC website <http://www.dstc.edu.au/>

In Australia, a number of cooperative research centres have done work on software that either has found or may yet find e-research application. The Australian Telecommunications CRC (ATCRC) has contributed to network and next-generation Internet development, and has developed the Cortec Systems Voice over Internet Protocol (VoIP) software; the CRC for Smart Internet Technology has developed software for application in education, science and healthcare; the CRC for Chronic

Inflammatory Diseases (CRCCID) has developed genetic and other databases and related integration and analysis tools with obvious research application; and the work of DSTC has already been mentioned.⁶⁵

Education vertical market opportunities

E-learning covers training provided electronically, whether via CD-ROM, online, satellite, or teleconferencing. E-learning suppliers include the following.

- *Content management firms* that develop technical tools (e.g. software used to create electronic content), which may be used to create content for clients on a fee for service basis or they may be licensed to the client to create their own content in-house
- *Suppliers of delivery mechanisms* for the digital content, which are often elements or entire learning management systems that focus on the delivery, administrative and logistics aspects of training systems
- *Solution providers and integrators* that provide complete e-learning solutions incorporating content management, delivery, administrative and logistics elements, and collaboration systems, such as systems enabling virtual classrooms

These products and systems are purchased by organisations wanting to train people electronically, generally either corporates or educational institutions.⁶⁶

Australia's national achievements in developing state-of-the-art shared online content and services for schools, vocational education and training, and higher education, are recognised internationally. Australia has been very successful in a number of areas, including national collaboration, web based services, standards and interoperability and in forming international strategic alliances.

Nevertheless, many challenges remain.⁶⁷ Different market segments face different prospects. Segments that appear stable and likely to continue to grow include: learning environments that provide access to learning resources and activities (e.g. virtual learning environments); authoring tools to design learning approaches and resources (including simulations); learning management systems (LMS) that support administration of learning and in some cases support linkages between learning and performance; tools to support the development and storage/retrieval of resources (e.g. content management systems); tools to support collaborative activities including learning; and live event systems or virtual classrooms.⁶⁸

Prospects for the content market are less clear, because it is more locally specific, because there are already major international players in the education publishing sector, and because it is more susceptible to in-house and non-market competition.

Within segments there is now a move away from teaching tools towards more integrated systems that draw together learning management, content management, communications and networking, and assessment and reporting into single systems. There is also increasing use of web-based brokerage engines that provide the

mechanism for educational institutions to make their course content accessible to students online.

When developing products for export, language and cultural factors play an important role in both educational content and in user interface requirements. Natural markets for Australian developers are, therefore, likely to be largely Anglophone, such as New Zealand, UK, US, Canada, Ireland and South Africa. There may also be a significant opportunity in the Asia-Pacific region and further afield in English language content and systems for semi- or non-English language markets like India, China, Korea and Thailand.

There is also value in experience and familiarity, and those markets from which Australia draws overseas students and into which it sells education services (e.g. China, Thailand, etc.) are likely to be more readily accepting of Australian educational software and multimedia content.

Market maturity, growth and orientation are also important factors. The biggest market for corporate e-learning is the US, with other national markets a distant second. European markets are less developed and tend, perhaps, to be somewhat European in their orientation. In all cases, an understanding of the structure and operation of the particular market and local cultural sensibilities will be essential, with the 'market' being relatively local (e.g. state) rather than national (e.g. US) or regional (e.g. Asia) in many cases. With regulation a key driver of development in the corporate training market, deep understanding of national and local regulation and its implementation will be essential for content developers targeting the corporate market.

Education software suppliers

There are a number of global players supplying the education vertical market from the ICT sector (e.g. Oracle, Sun Microsystems, etc.), the publishing sector (e.g. Thomson, Reed Elsevier, etc.), the education sector (e.g. WebCT), and the consulting services sector (e.g. Accenture). These firms operate as powerful forces in many national markets worldwide. In most markets, there are also many smaller local players.

Market segments vary. The e-research content segment tends to involve a larger proportion of major international players than do such segments as e-learning tools and course content. There are also global players in the network and connectivity segments, with many smaller local players in the web and value-added services segments.

The education vertical software market can be divided into three core segments (i.e. e-learning, e-research, and business and administration), and then into the major supply categories (i.e. software products, content and value-add, and system and network engineering and integration). The firms listed in the figure and in the following tables are indicative of activities in the sector. Their inclusion is not intended to be an endorsement, nor the exclusion of the many others supplying the market a criticism.

As is the case throughout this report, these firms are more or less specialists in the provision of educational software and related content and services. There are many other, multi-product firms, non-specialist and in-house producers that are not included.

Table 4. US e-learning stock tracker, June 2005

<i>Firm name</i>	<i>Cap USD (June 2005)</i>	<i>Profit/loss last year</i>	<i>Focus of activity</i>
Macromedia	2,842	842	e-learning content authoring tools
Blackboard	2,589	589	LMS—academic, higher education
Webex	2,259	259	Live e-learning provider
HealthStream	2,231	231	Provider of medical e-learning content and LMS
Renaissance Learning	2,130	130	LCMS, LMS, KM (parent firm of Generation 21)
Laureate Education	2,118	118	Online Degree Programs (Formerly Sylvan Learning)
Plato Learning	2,051	51	Custom development, content provider
Saba	2,010	10	Learning management system provider
Thomson Corp	1,918	-82	Content provider (parent firm of NETg)
Intellexis Plc	1,872	-128	e-learning content provider
e-College	1,819	-181	Infrastructure for Academic
SumTotal	1,630	-370	(Former Click2Learn and Docent) LMS, LCMS, LEL
Centra	1,470	-530	Live e-learning provider
Epic Group	1,449	-551	Consulting, custom development
Skillsoft	1,299	-701	Content provider, LMS and custom development
iLinc Communications	1,277	-723	Live e-learning, custom dev, software simulation
AREL Communication	1,246	-754	Live e-learning provider
VCampus Corp	948	-1,052	Hosted learning management system provider
Futuremedia	917	-1,083	Custom dev, LMS, consulting, content provider

Source: <http://cedar.forest.net/brandonhall/bc/stock.htm>

Box 10. Creative Windoware Pty Ltd

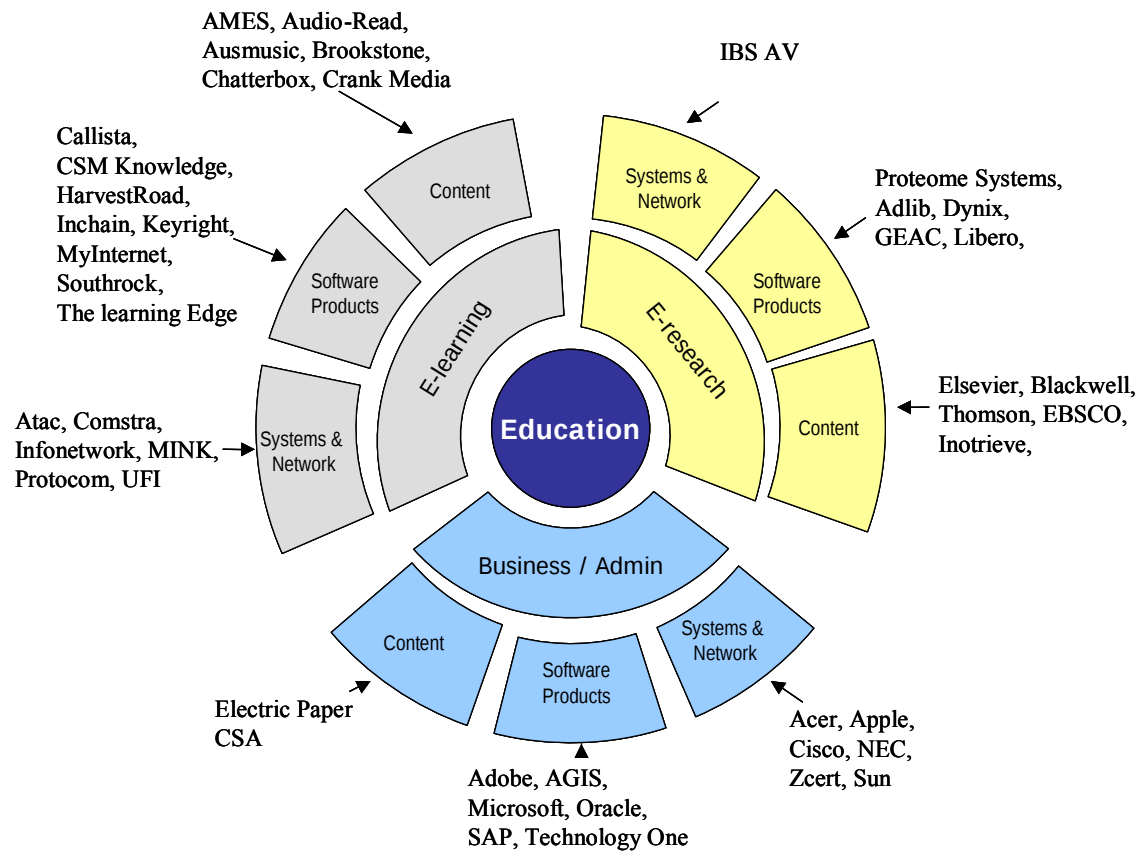
Creative Windoware Pty Ltd is an Adelaide based company that creates and sells e-learning software internationally, with its main markets being the United States and Europe. Creative Windoware pioneered computer based training to improve reading proficiency in 1996 and now conducts cutting-edge Internet commerce through its award-winning websites www.speedreading.com, www.rocketreader.com and www.free-online-books.com

The company's software product RocketReader allows users to directly practise training techniques on live websites, Word documents, Excel spreadsheets, PowerPoint presentations, text files, RTF files and PDF documents. The software also tests and develops reading comprehension and provides many versatile memory training modules. RocketReader has stellar educational potential, suitable for use by six-year-olds through to adult readers. RocketReader is also available in easy-to-install multi-user editions for use in schools, colleges and universities.

RocketReader improves learning outcomes for students and improves fundamental skills across a broad age range, enhancing productivity and efficiency. RocketReader's advanced artificial intelligence methods provide success in the difficult task of breaking lifelong poor reading habits. These techniques keep the user in an optimal learning zone so they can master fast, accurate reading techniques.

Source: DCITA (2005) *Secrets of Australian IT innovation*, Department of Communications, Information Technology and the Arts, Canberra

Figure 4. The education vertical software market map



Source: CIER Analysis.

Table 5. Some e-learning firms and products

Etechgroup	Etechgroup pursues a strategy of building alliances with key customers, hardware vendors and content suppliers, and it has become a leading systems developer. Etechgroup flagship products, FourPoint Learning for corporate, government and institutional clients and the StudyWiz virtual learning environment for schools, are generating increasing interest internationally, with major installations in the United Kingdom, Hong Kong and Malaysia as well as France. ⁶⁹
HarvestRoad	HarvestRoad is a software developer based in Perth, Western Australia. It develops specialised content management software for use in organisations that implement online learning and knowledge management systems. Its business is focused on the continual development of the flagship product HarvestRoad Hive, an independent, federated digital repository system for reusable knowledge objects for: schools, vocational education, higher education, publishers, corporate and government clients, and education service providers. ⁷⁰
Inchain	Inchain is both a developer of products and a service provider. Its business is focused on using and developing technologies that add a social interface (i.e. talking characters) to software applications and the Internet, thereby making the experience of interacting with computers more human and easier for end users. Inchain sells and supports its own products, developing software, characters and online applications for its clients. Inchain aims to become a leading social interface provider. ⁷¹ Inchain was short listed for this year's iAwards.
My Internet	My Internet has joined forces with CSM Group to form a \$30 million Australian e-learning supplier. My Internet's products and services, including myclasses, mydesktop and webmail, are used by more than 3600 schools and one million users in Australia, New Zealand, the United Kingdom and Hong Kong. The key to my Internet's success has been its willingness to work closely with education authorities, schools and teachers to understand current and emerging issues. ⁷² My Internet was short listed for this year's iAwards.
The Learning Edge	The Learning Edge is now part of the Dytech Group. The Learning Edge product (TLE) is an advanced Learning Content Management System (LCMS) allowing educators to discover, reuse, create, manage and deliver educational material electronically. Based in Hobart, Tasmania, The Learning Edge has worked closely with the Tasmanian Department of Education, allowing the technology to be tested and trialled in a real educational environment. The Learning Edge is also a major supplier to Queensland schools. One feature of the TLE product is its integration to the Blackboard Learning System (See above). ⁷³
XSIQ	XSIQ is recognised as a leader in curriculum content development. The company, which has its origins in education, creates subjects that can be installed on a district or school server. The schools can then modify the subjects to assist with the delivery of learning at the school. As part of its strategy to increase its market share, XSIQ creates strategic alliances with governments, educational associations and associated channel partners that service the education sector. XSIQ has an established market in Australia and currently

exports to the United States and United Kingdom.⁷⁴

Ziptales Ziptales is a multimedia publisher in the primary education market. Originally developed by Wizard Books, and drawing on many years in the educational book publishing area, the firm has gone on to specialise in e-learning. Ziptales is an interactive online English language program aimed at primary students. It offers core curriculum content (reading, listening and writing) and exploits the benefits of broadband with animations, music and voice readings. The product is delivered primarily online using a subscription model.⁷⁵

Source: CIIER Analysis.

Box 11. QSR International Pty Ltd

The initiative to write a computer program when none existed at the time of a major qualitative social research project by La Trobe University in 1982 was the starting point for one of Australia's most successful export software companies, QSR International Pty Ltd.

It is today the recognised world leader in qualitative research software and services. QSR develops and markets a suite of products for analysing text and other non-numerical data. QSR has its origins at La Trobe University, where the first commercial product, NUD*IST software, was created by Tom Richards to support a social research project by Lyn Richards.

NUD*IST draws its name from the program they developed for handling 'nonnumerical unstructured data by techniques of indexing searching and theorising'. It quickly became the front-line innovator in the qualitative computing field and was being used in 20 countries before it was ever advertised. Before this development, in the 1980s, computers simply couldn't handle non-numeric data, so qualitative research still required pen and paper.

In May 1994, QSR was formed and became part of an incubator centre at the La Trobe University Technology Park. In 1995, the company was restructured in a management buy-out. It also eventually outgrew its university location and moved to premises in the Melbourne light-industrial suburb of Doncaster.

During this time, the program continued to evolve and, in 1999, QSR released a second product, NVivo, which pioneered new methods of accessing and linking data. It was widely regarded at the time as ushering in a new generation in qualitative software. By the year 2000 both NUD*IST (by now Version 6) and NVivo were selling as first-choice research tools in 80 countries.

QSR products are used by researchers and managers in academic, business, government and non-government organisations undertaking health and medical research, social science, education, evaluation, market research, counselling, software engineering, criminology, management studies, economics and many other fields of study and work. The company now employs 25 staff in Melbourne and two in North America, and uses a network of trainers and consultants around the world.

In October 2001, QSR was announced as the winner of the 'Information and Communication Technology Award' in the Governor of Victoria Export Awards for 2001, Victoria's most prestigious export award. The award cited the company's international focus and its ability to provide leading edge QDA software solutions. QSR itself has been the sole funder of its R&D; its founders are still with the company: Tom Richards as its chief scientist and Lyn Richards as Director of Research Services.

Source: Australian Research Council, et al. (2002) *National survey of research commercialisation*, Canberra.

Table 6. Some e-research firms and products

Celera Discovery System	Celera Discovery System is an integrated source of information based on the human genome and other biological and medical sources, and is an important tool in drug discovery efforts. ⁷⁶
Proteome Systems	Proteome Systems develops, manufactures and commercialises technology solutions, including instruments, software and associated products that enable proteomics research. The company is organised into two distinct but complementary businesses: Discovery and Diagnostic, and Technology. The technology business has developed a suite of products for the acceleration and optimisation of proteomics-based research, including integrated systems, advanced instruments, bioinformatics software and consumables, in partnership with companies with complementary technologies (e.g. IBM in IT hardware and middleware, Shimadzu and Thermo Electron in mass spectrometry). ⁷⁷
CSA	CSA is a worldwide information company which specialises in publishing and distributing, in print and electronically, bibliographic and full-text databases and journals in the natural sciences, social sciences, arts and humanities, and technology fields. A privately held company, CSA is headquartered in the US and has offices in Australia, Hong Kong, Japan, Europe and the United Kingdom. Researchers in more than 4000 institutions worldwide use CSA information resources, and CSA's print journals are used in more than 80 countries. ⁷⁸
EBSCO Information Services	EBSCO Information Services is a leader in providing information access and management solutions through print and electronic journal subscription services, research database development and production. It provides online access to more than 100 databases and thousands of e-journals, and to e-commerce book procurement systems. ⁷⁹
Innovative	Innovative supplies products that are installed at universities, community colleges, public libraries, consortia, law libraries, medical libraries, art and museum libraries, school libraries, and specialty libraries, and used by thousands of libraries of all types and sizes in 42 countries around the world. ⁸⁰
OVID	OVID provides: access to thousands of the world's most influential journals, texts, and databases; tools for searching and navigation; and a variety of training and customisation services. ⁸¹
ProQuest Information and Learning	ProQuest Information and Learning is a leader in collecting, organising and publishing information to researchers, faculty, and students in libraries, government, universities, and schools in over 160 countries. ⁸²

Source: CIIER Analysis.

Box 12. Audio-Read

Audio-Read has developed a cost-effective and simple system for the narrative delivery of books, newspapers, magazines and any digitally created information to vision impaired and non-vision impaired readers anywhere, anytime. The system comprises a back office file management package, a client receiver and recording module and a portable player designed by Audio-Read called an audio navigator. The secure digital multicast system and patented portable audio navigator have received endorsement from companies and organisations around the world.

The Audio-Read system provides enormous savings over traditional delivery and playback methods and opens up a world of previously unavailable content for the user. Books and magazines can be delivered within hours of request and for the blind and visually impaired it brings speed, ease of access, document storage and portability of play back. The special software and hardware combination protects the intellectual property rights of content owners.

Audio-Read is the only company in the world providing the complete end-to-end solution for the delivery of the digital spoken word. Audio-Read are currently implementing their product in both public and specialist libraries around the globe and are working closely with agencies in Australia, United Kingdom and the USA to customise a solution to suit their needs. Audio-Read has secured content agreements with major audio book and print publishers including BBC, ABC, *The Economist* magazine and Fairfax newspapers.

Source: DCITA (2005) *Secrets of Australian IT innovation*, Department of Communications, Information Technology and the Arts, Canberra.

Innovation base and support infrastructure

With in-house and non-specialist development such a feature of the education vertical, there are many players that cross and span the boundaries between the innovation and support base, clients of and competitors to specialist education software development firms.

Many, if not most of the education services providers in the post-secondary sector develop e-learning content and systems for in-house and external use. For example, the Macquarie University e-Learning Centre of Excellence (MELCOE) claims to be a focal point for e-learning infrastructure and standards development, and a leader in implementing global standards and specifications for learning technology. Through collaborations with educational organisations, government and commercial partners, MELCOE fosters the adoption of the next generation of distributed e-learning and information systems.⁸³ There are number of such centres around Australia that span e-learning research, practice and development.

Box 13. E-learning software lacks academic direction

Melbourne researchers who are developing software capable of monitoring and assessing the usefulness of teaching and e-learning software have found that many are lacking an academic direction.

A combined project between the University of Melbourne and Monash University, involving four separate engineering and computing departments across the two universities, is developing an agent framework called PEDANT for monitoring user responses in both stand-alone and web-based educational software tools. A key finding of the PEDANT project to date has been that educational software often has little to do with a defined academic or educational position; the software does not follow any particular educational theory.

Advances in technology in the past decade have seen vast changes in the way the learning environment operates, with online courses, software teaching packages and instructional training tools now accessible to almost anyone who wishes to further their education. However, Professor Leon Sterling from the Intelligent Agents Group of the Department of Computer Science and Software Engineering at the University of Melbourne says there has been little work done to objectively determine how students use the software and whether educational objectives are being met.

PEDANT monitors the behaviour of students as they use an educational software program or Internet resource. It then evaluates this use against the educational objectives of the software. A prototype agent determines whether students using a program for animating computer science algorithms use it primarily for concept exploration or for testing.

Professor Sterling says that one of the reasons PEDANT revealed a lack of a defined academic position may be that, despite a decade of development in e-learning, communication between software engineers and educationalists continues to remain almost non-existent. 'There are courses on web design and graphics, there are courses for teachers to become familiar with software development, but there are virtually no courses that offer a defined program on the application of software engineering to the various aspects of education,' he says. Professor Sterling believes the consequence of this is that educational issues are not central to the thinking of the software engineer developing educational software, while educationalists contribute little to the development of educational models that may be relevant to the complexities of e-driven learning environments.

Source: University of Melbourne (2004) media release, 3 May 2004.

Other organisations that are key parts of the supporting infrastructure also sometimes operate in the software development space. For example, the Education.au capability statement suggests that its business is to develop and manage online services that are of benefit to the Australian education and training sector, and to advance the use and support of information technology in teaching and learning, research and educational administration.

It claims that unlike many commercial operators, it provides much more than just website design services. Extensive knowledge of the education and training sector means it can work with an organisation to effectively analyse business requirements, customise existing platforms, technologies and standards, and construct creative business solutions to meet an organisation's immediate and long term needs.

Education.au provides information management services which cover a range of activities, including overall project management, the identification of online resources

for use within education and training programs, the assigning of metadata to these resources, and data analyst work, such as coding course and career/occupation data to national standards.

Web services have been developed using standards and XML. Search-and-browse application programming interfaces (APIs) enable user web sites to interrogate this ‘wholesale’ database asset and return query results to the user’s own web environment. In this way, stakeholders are able to ensure seamless and transparent access to the discovery tools built for EdNA Online and repurposed to meet the needs of stakeholders in the education and training sector.

Education.au claims demonstrated expertise in the implementation of scalable web solutions across both Microsoft and SUN platforms.⁸⁴ Such activities make the education software market a complex and challenging space for specialist software developers.

Education market conclusions

E-learning is widely seen as a major growth market, suggesting considerable opportunity for software suppliers. E-research is also rapidly growing. However, there are number of issues to consider. There are questions as to how much of the market will be addressable by independent specialist software developers, and how much of the software used will be commercially produced.

Education is characteristically a services market, offering relatively few opportunities to sell stand alone software products. Moreover, education and research exhibit a strong tendency for non-specialist and in-house development, and for the adoption of open source/open access, freeware, shareware and ‘sharedware’ (i.e. software that is created by and freely distributed among teachers and researchers). The market addressable by specialist commercial software developers is much smaller than overall e-learning activity would suggest.

Such factors as accreditation and approval, the limited number of key accreditation gatekeepers, the importance of standardisation, the emergence of purchasing consortia, etc. also tend to limit market opportunities. These markets are characterised by a small number of major clients and millions of individual clients, challenging commercial marketing and sales strategies.

There are opportunities in such areas as improved functionality and integration of the various system elements, but it is increasingly the case that such opportunities require a certain scale to exploit. In the key areas of learning tools and systems, there are already major players in the marketplace. There are also major established players in many areas of content development and access. Moreover, where these are being challenged (e.g. open access publishing), the tendency to adopt open access and/or open source systems limits commercial market entry opportunities, unless or until firms develop sustainable open source/open access business models. Again, this emphasises the importance of service delivery business models—it is increasingly a services, not a product market.

For all these reasons, the opportunity for Australia to grow firms domestically to become internationally competitive suppliers of software products into the e-learning vertical application market may be somewhat more limited than market hyperbole during the 'dot com' boom years would have suggested.

E-research clearly has some major players, although many are established international firms. Demands for interoperability and preference for open source solutions are likely to limit opportunities for Australian software firms, although there may be significant activity in the development of middleware and tools to support the rollout of e-science and grid computing systems.

The focus of this study is primarily vertical applications markets, with secondary focus on horizontal applications in the education vertical market. Nevertheless, as in other vertical markets, ERP and other business and administrative systems are a major focus of spending. There are major projects in a number of Australian states focusing on updating or replacing business and administrative systems, and there are likely to be significant opportunities in tailoring such systems to meet the needs of education institutions.

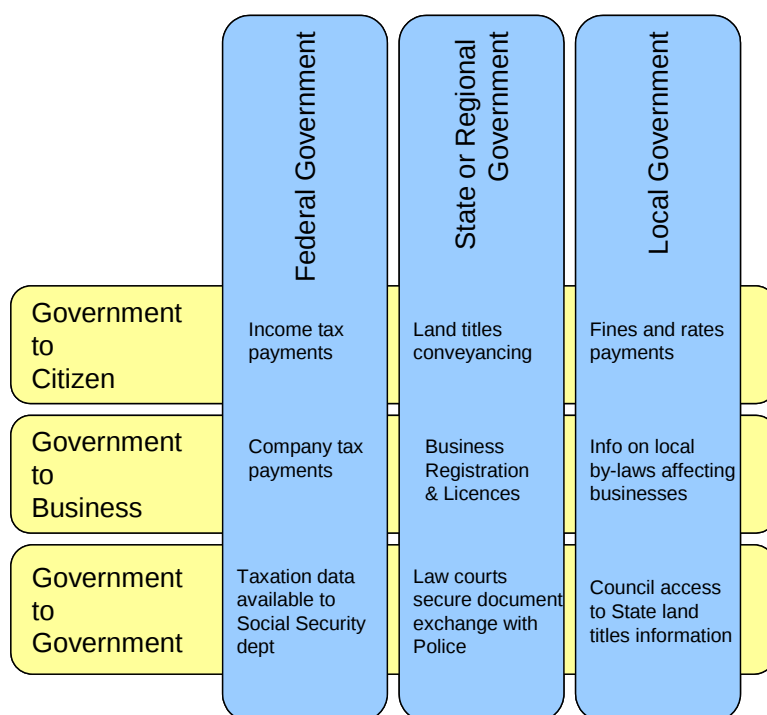
Government

The government vertical market includes software products and services that manage government information and knowledge, and products and services for dissemination and service delivery, generally referred to as e-government. E-government is the practice of using Internet-based communications techniques and e-commerce to deliver services and information to a country's or region's citizens and businesses.

Many governments see value, for their citizens, businesses and their own operations, in implementing e-government services, thereby simplifying service delivery, reducing layers of bureaucracy, improving access to relevant government services, reducing costs through integration and elimination of redundant systems and processes, and improving transparency and accountability in government processes.

E-government is sometimes categorised in terms of the layer of government offering the service and the target audience for the service (e.g. federal, state or local governments offering services to citizens, businesses and other governments).

Figure 5. Categorising e-government services (with examples)



Source: CIIER Analysis.

Our investigation suggests that many of the high-profile e-government projects around the world are custom made web applications. This is perhaps not surprising as a government's processes are determined by the rules and legislation of the country or

region. These can differ markedly from place to place, and even from agency to agency and hence, the need for customised developments to cater for the local rules.

Nevertheless, the sub-components that make up these custom applications can, to some extent, be commoditised and become a standardised package that can be offered to a broader e-government market.

Software market categories from other areas of ICT activity that are relevant to the e-government vertical include the following.

- Basic infrastructure, including operating systems and servers, databases, application deployment platforms, measurement tools
- Security—including smartcards, authentication, encryption
- Specialist areas (geospatial and departmental)—including geospatial and departmental applications such as health and safety
- Customer relationship management systems (CRM)—to support personalisation of interaction with citizens and businesses
- Tools for constructing services (payment and taxation, content management), including payment gateways and transaction systems, digital rights management, secure guaranteed file delivery, content management systems, development tools and rich web content tools, tools for creating mobile services.

The government software product system

The government software product system consists of large government clients on the demand-side that include national, state and local government agencies. The demand side is concentrated to a more significant degree than in other markets by centralised purchasing and planning (e.g. CIOs, coordinating committees etc acting on behalf of groups of buyers). Such concentrated procurement bodies and outsourcers who have secured large long term contracts, can become key market gatekeepers, and can impact significantly on the range of software products and services available to government buyers.

The accreditation and prequalification of potential software suppliers to the government markets, through panels or various endorsement processes, play a crucial role in the management of the government market. Some endorsed suppliers may be advantaged by easier market access or limited competition, whilst other software suppliers may be disadvantaged by not meeting criteria when competing for particular tenders.

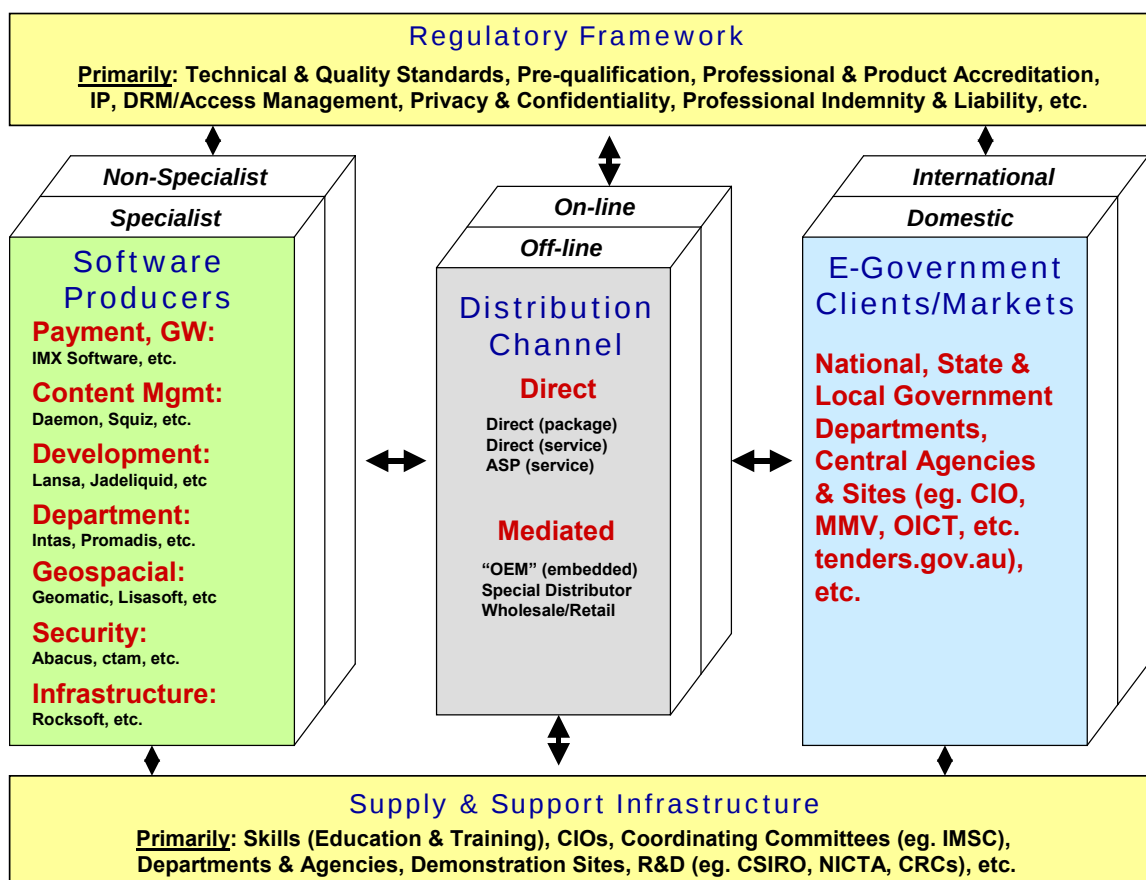


Figure 6. The government product system

Source: CSES Analysis.

With the majority of the identified activity to date being in the form of custom development services, collaboration with clients and producer-client linkages are important in innovation and development. In some specialist areas, there may be other opportunities to link into R&D expertise (e.g. the CRC for geospatial information). As global multinational ICT services suppliers dominate in government procurement, developer relationships and partnering with the multinationals is a key path to market. Conversely, the idiosyncrasy of local laws and regulations support may enable local firm participation. For smaller firms attempting to win new business credibility will be vital, making local demonstration sites and clients willing to field inquiries essential.

E-government markets

In a 2004 global survey, the United Nations examined the government websites of 191 member countries as part of an overall measure of the capacity and willingness of countries to use e-government.⁸⁵ These data are used to create the e-Government Readiness Rankings, which draw a number of indicators into key indices, including the following.

- Web Measure Index—the level of sophistication of government web presence
- Telecommunications Infrastructure Index—a measure of sophistication of use and connectivity
- Human Capital Index—a measure of literacy and education levels
- E-participation Index—a measure of the openness, relevance and availability of government information, and the level to which it encourages a dialogue with citizens

Complementary to the UN study, Accenture conducted a separate survey which examined the e-government online presence in 22 countries over the five years to 2004, and evaluated the level of service offered and extent of customer relationship management. While the UN survey is broader in scope, there are common elements with Accenture's. It is instructive to examine both surveys in exploring the status of e-government in various countries.

The United Nations recorded overall steady progress in the quantity and level of sophistication in e-government offerings between 2003 and 2004. This included a 15% increase in the number of countries offering transactional services. Accenture presented a more subtle picture, in which the advances in e-government are slowing down. They suggested:

This year we see clear evidence that, with few exceptions, e-government advances are diminishing. The average maturity increase across all countries in 2004 was 5.6%, in comparison to an average of 7.4% in 2003 and 11.5% in 2002.⁸⁶

According to Accenture, the advances seen by the early leaders in 2000 are in 2004 nowhere near as dramatic as in countries like Malaysia, which has been making steady gains and is now closing on the maturity of the early leaders. Of the leading nations, Canada and Singapore are making the most noteworthy advances.

Table 7. E-government readiness and maturity rankings, 2004

<i>E-government readiness ranking</i>		<i>E-government maturity ranking</i>	
<i>Rank</i>	<i>(UN)</i>	<i>Rank</i>	<i>(Accenture)</i>
1	United States	1	Canada
2	Denmark	2	United States
3	United Kingdom	2	Singapore
4	Sweden	4	Australia
5	Republic of Korea	4	Denmark
6	Australia	4	Finland
7	Canada	4	Sweden
8	Singapore	8	France
9	Finland	9	Netherlands
10	Norway	9	United Kingdom
11	Netherlands	11	Belgium
12	Germany	11	Japan
13	New Zealand	11	Ireland
14	Iceland	14	Germany
15	Switzerland	15	Norway
16	Belgium	15	Spain
17	Austria	17	Malaysia
18	Japan	18	Italy
19	Ireland	19	Mexico
20	Estonia	20	Portugal
21	Malta	21	Brazil
22	Chile	22	South Africa
23	Israel		
24	France		
25	Luxembourg		

Sources: United Nations and Accenture.

Figure 7. Features currently offered on government portals (% adoption)

Source: United Nations.

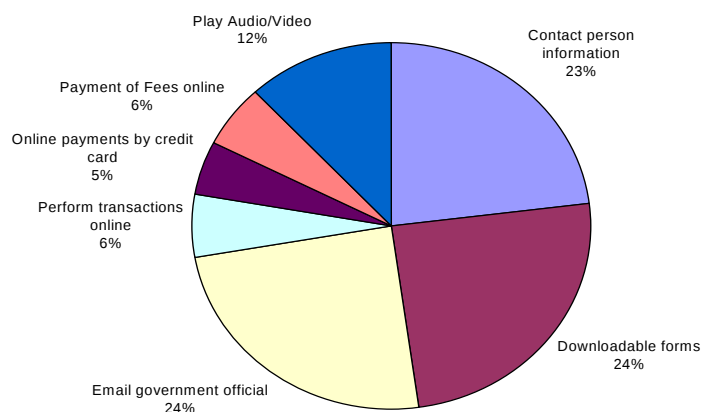
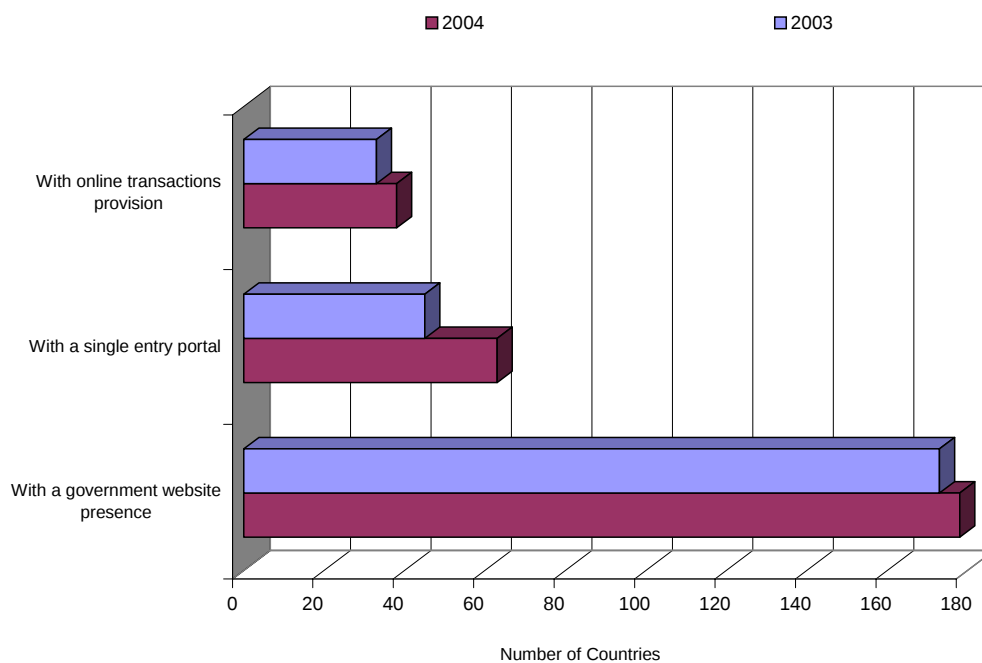


Figure 8. UN Member countries web portal evaluation



Source: CIER Analysis.

Australia

Australia ranked sixth in the UN e-readiness rankings and fourth in Accenture's e-government maturity rankings. It is one of the leading nations in the development of e-government services.

Australia was an early e-government mover. Like the other countries in the top four, it has reached a very high level of service breadth, with the vast majority of applicable national government services online by December 2001. Today, the government seems to have embraced many principles of high-performance government: it has implemented outcomes-based performance management, and is working toward greater financial control and accountability.⁸⁷

Australia is seen to be committed to e-government programs at local, state, and federal levels, with various programs aimed at giving domestic suppliers opportunities and enhancing their reputation when marketing overseas.

At the federal level, the Australian Government Information Management Office (AGIMO) fosters the efficient and effective use of ICT by Australian Government departments and agencies. It provides strategic advice, activities and representation relating to the application of ICT to government administration, information and services.

In particular, AGIMO oversees e-procurement, business case assessment and e-government portals on behalf of the Australian Government.

The Information Management Strategy Committee (IMSC) is a high-level policy body overseeing big-picture issues for ICT adoption in the Australian Government. It also promotes closer collaboration between agencies in the next phase of ICT implementation, and encourages a cooperative approach to decisions on standards, investment, security, privacy, shared infrastructure and reuse of intellectual property to ensure that these reflect the impact and benefits across government, rather than on individual agencies alone. A committee comprising the chief information officers (CIOs) of Australian Government departments that are high ICT users reports to the IMSC. The Australian Government e-government objectives as set out in the 2002 e-Government Strategy paper are to:

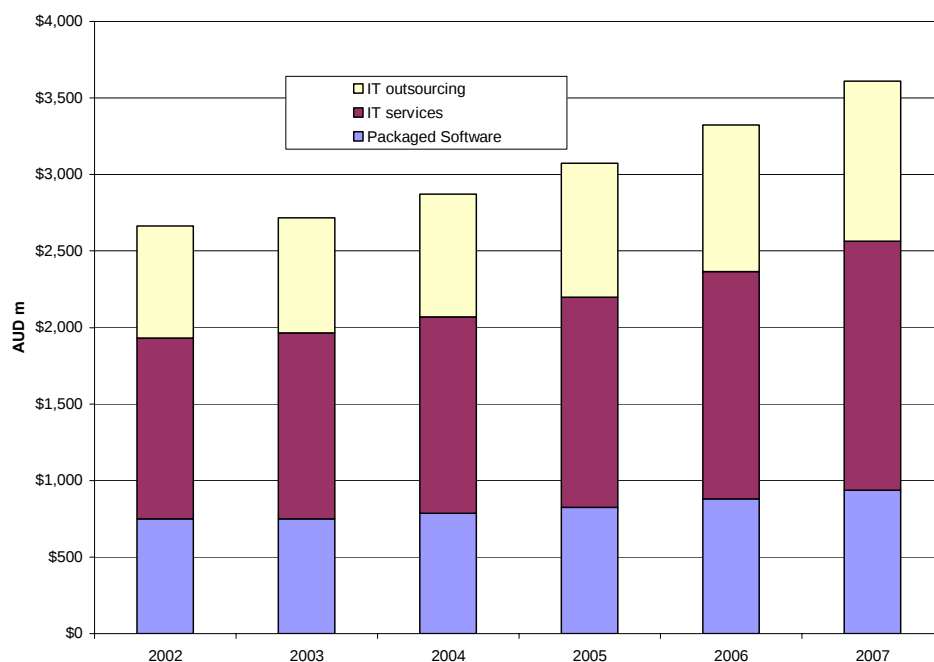
- achieve greater efficiency and a return on investment;
- ensure convenient access to government services and information;
- deliver services that are responsive to client needs;
- integrate related services;
- build user trust and confidence; and
- enhance closer citizen engagement.⁸⁸

Agencies already cooperate when developing policies and standards. Similarly, opportunities will continue to be taken to collaborate on ICT procurement both by leveraging government's collective buying power and by increasingly reusing valuable intellectual property across the Australian Government.

IDC reported that, of total government software spend in 2005, 60% is expected to be federal government expenditure and 40% state and local government.⁸⁹

The level of activity varies significantly between states. We believe that this is partly because the different states are at different phases of their implementation programs and partly because they take various approaches to managing their software and services acquisition strategies. Victoria has an established and longstanding tradition of e-government activity and actively monitors the sector itself. Queensland has a clearly defined and ambitious set of goals that suggest that it too is a highly promising market. The Northern Territory also seems to have ambitious plans. This is no doubt encouraged by funding assistance from the Commonwealth.

In New South Wales, the e-government strategy is managed by the Government Chief Information Office (CIO), under the Department of Commerce. The CIO coordinates several programs, including connect.NSW (a program to improve online services) and CTC@NSW (a program to encourage community development of technologies). The 2002–05 corporate plan for the Chief Information Office outlined a number of initiatives, focusing on: continuous improvement of ServiceNSW, the NSW government portal; ongoing funding of the connect.NSW, a program to move government services online; an ICT security program to protect government ICT assets; a privacy program; a government licensing system (GLS), a program to administer business and occupational licences online; and improved online directories of government services (i.e. the government's white, blue and greenpages).⁹⁰

Figure 9. Australian government software and services market

Source: IDC special report 2004 (used with permission). CIER Analysis.

The Victorian Government appointed the state's first chief information officer (CIO) and chief technology officer (CTO) in November 2003. These were the first of such positions in any Australian state or territory.

The Office of the CIO is responsible for ICT policy and strategy within government and has whole-of-government responsibility for:

- innovative use of ICT to transform government service delivery;
- investment in ICT to address the government's priority outcomes;
- strategic planning for ICT deployment across government; and
- architecture planning and standardisation of corporate ICT infrastructure.

The chief technology officer at the Department of Infrastructure has responsibility for the management and delivery of whole-of-government ICT contracts and projects such as the telecommunications purchasing and management strategy (TPAMS), Project Rosetta and Victoria Online.

Victoria's e-government strategy is managed by Multimedia Victoria (MMV), whose e-government portal provides access to business case templates and web standards as well as other resources and information. E-government website development is coordinated by departments, but all developments must be registered with the main government portal, Victoria Online. In May 2005, the Parliament of Victoria's Scrutiny of Acts and Regulations Committee released the *Victorian electronic democracy* report.⁹¹ It examined such things as webcasting, online policy, collaboration, and other opportunities to promote citizen access. The report made some 90 recommendations.

- Employ ICT to facilitate public participation in democracy

- Improve web accessibility standards
- Ensure departmental compliance to website standards
- Allow local governments to participate in aggregated tendering with the state government for such things as content management systems
- Make electoral and candidate information available electronically; commencing evaluations and pilots of electronic voting machines
- Trial online consultation with citizens
- Redesign the parliamentary website to improve information access and include webcasting

Victoria recently made available a \$71 million online land title management system.⁹² It also recently announced new ICT contracting arrangements.

Western Australia created the Office of e-Government (OeG) in February 2003. It is responsible for ensuring that e-government expenditure conforms to the e-government strategy, which described the role of the OeG as being to foster improvement in e-government by leading the e-government agenda, assisting with cultural change, establishing government mechanisms, and promoting interoperability.⁹³

The strategy places the onus on individual government agencies to identify relevant e-government projects, prepare the business case and manage the project. The strategy does not identify any specific projects that should be undertaken.

Western Australia has several initiatives underway.

- Electronic advice of sale (EAS2), a system for enquiring on, and recording land conveyancing transactions
- eBriefs, for the secure transmission of police and court documents
- Tourism eMarketplace, an online presence for the state's tourism industry
- Shared land information platform (SLIP), a platform for land information and geospatial data⁹⁴

The OeG also promotes a technology specific program called .NET Solutions-WA, which seeks to encourage Microsoft .Net solutions.

South Australia's e-government initiatives fall under the auspices of the Minister for Science and Information Economy, with assistance from the Information Economy Advisory Board and the Science, Technology and Innovation (STI) Directorate, a unit of the Department of Further Education, Employment, Science and Technology. The STI Directorate's role is to provide strategic IT advice on the information economy and ICT. It is required to facilitate programs to raise awareness and understanding of the information economy among specific target groups and facilitate bids for significant Commonwealth grants. Projects under the STI Directorate include the following.

- EbizSA, a program to facilitate e-business in South Australia
- Digital Bridge Unit, a group responsible for implementing access and education programs for people with less access to IT

- Broadband SA, a program to encourage broadband adoption, in conjunction with the equivalent commonwealth program
- SABRENet, a broadband rollout program for universities and research institutions

South Australia does not appear to be pursuing a highly public e-government strategy, but it is focusing on general improvement of IT capability across the community, research and business sectors.

In Queensland, the Office of Government ICT (OGICT) released a strategy paper in December 2004, called the *Smart directions statement for information and communications technology within the Queensland Government*.⁹⁵ It defined the overall Queensland strategy for ICT, for which the Office of Government ICT is responsible.

The Office has overseen several projects, including: an integrated justice information strategy (IJIS), allowing agencies to exchange information on offenders; Smart Service Queensland (SSQ), to facilitate integrated generic service delivery to business and the community; and Information Queensland (IQ), an online tool for providing physical, environmental and social data about Queensland (e.g. maps and satellite imagery).

The *Smart directions* statement outlined several e-government initiatives.

- Repositioning the business model of Smart Service Queensland (SSQ)
- Expanding the use of the secure government intranet (GovNet)
- A whole-of-government approach for IT security, including single-point identity authentication
- Secure mobile computing for remote access for government employees; seamless access to government agency information on the web;
- More coordinated disaster recovery planning
- A strategic framework for telecommunications

An e-government master plan for the Northern Territory was approved in 2004, setting such targets as establishing a territory business register; enhancing meta data availability; establishing online requisitions; making all fines, fees and charges payable online; and enabling medium and complex business transactions. By February 2004, 41% of applicable Northern Territory Government systems were available online, with 16% in progress, 20% not online/not started and the remaining 23% either not assessed or considered unsuitable.⁹⁶

In Tasmania, between 2000 and 2003, a federally funded trial program called TIGERS was undertaken. It was designed to explore e-government opportunities in Tasmanian.⁹⁷ This program ran a number of trials, some of which have been adopted as e-government applications, including: Transport Online (continuing); Fish Online (continuing); Planning Application Online (pilot, not continuing); Networked Online Veterans Electronic Lodgement (continuing); and Government Electronic Integration (pilot, not continuing).

These various initiatives illustrate the range and diversity of e-government and related government ICT activities around Australia.

International e-government markets

An indication of the status of various international markets for e-government can be obtained by the e-government readiness and maturity rankings (outlined above). The following examination of three regions (North America, Europe and Asia) and several countries within these regions illustrates some of the key drivers for the development of markets and some of the issues relevant to access for Australian firms.

We have examined a selection of markets that were selected on the basis of the availability of data, and being representative of a mixture of advanced economies, with sophisticated e-government offering and developing countries where their economic growth may indicate opportunity.

Asia-Pacific

According to IDC, Asia-Pacific e-government spending was USD 880 million in 2002, and was expected to increase at a compound annual growth rate of 11% to 2007.⁹⁸

China was expected to spend USD 9.38 billion on public sector IT initiatives in 2003, and Singapore USD 780 million.

Table 8 Asia-Pacific e-government spending forecasts, 2005-07

Year	2005	2006	2007
Spend (USDm)	1,201	1,332	1,478

Source: IDC.

In 2002, China introduced a program to promote the wider use of information technology and guidelines on handling government affairs online.⁹⁹ A listing of e-government websites in China is made available by the US Congressional Executive Commission on China (www.cecc.gov).

Our evaluation of these websites suggests that most provide information for various provinces and cities within China. This impression is reinforced by China's relatively low ranking of 67th in the United Nations e-government readiness rankings. It was estimated that the market for e-government software would be 5.8 billion yuan (USD 699 million) or 11% of the regional e-government market in 2004. It was also suggested that the Chinese government's unique structure and laws would give domestic firms an advantage.¹⁰⁰

E-government in Singapore is coordinated by the Infocomm Development Authority (IDA). Singapore commenced its first e-government action plan in 2000 and is currently implementing its second plan, which is due for completion in 2006. It is a three-year, SGD 1.3 billion initiative.¹⁰¹

Singapore claims to have already e-enabled all government services that can be e-enabled, and the plan will strengthen these 1600 e-services by ensuring that 90% of the government's customers use e-services at least once a year, and 90% of these users are satisfied with the overall quality of e-services.¹⁰² IDA is investing SGD 30 million annually in trials of mobile services, web services, portals, wired and wireless network

infrastructure.¹⁰³ As a result, Singapore is a world-class practitioner of e-government, with a UN e-government readiness ranking of eighth, and an Accenture maturity ranking of second.

Given the level of sophistication, opportunities in Singapore may prove limited, and we would expect that existing suppliers would already have close relations with the government and demonstrated credibility.

Malaysia's e-government strategy is coordinated under the aegis of the MultiMedia Super Corridor. Its Electronic Government Application includes seven projects: project monitoring system (SPP II), human resource management information system (HRMIS), generic office environment (GOE), electronic procurement (EP), electronic services (E-Services), electronic labour exchange (ELX), and E-Syariah (an online Islamic law project).

Malaysia ranks 43rd in the UN e-readiness rankings and 17th on the Accenture maturity rankings. The discrepancy in ranking may be due to the inclusion of extra countries in the UN survey, but may also indicate differing views on the level of success achieved to date. If we isolate the web-measure component of the UN index, Malaysia ranked 43rd, behind such countries as Bulgaria and Venezuela. The Malaysian government has shown a clear intention to foster its IT industry, and given the e-government improvements already made we anticipate that Malaysia will provide opportunities for Australian software firms.

United States

US federal spending on e-government solutions is expected to increase from USD 4 billion in 2004 to nearly USD 6 billion by 2009, an increase of 8.4% pa. The key drivers for federal e-government expenditure are:

- the President's key 24 areas of e-government focus, as defined in the President's management agenda;¹⁰⁴
- greater pressure for oversight by the Office for Management and Budget; and
- the impact of the Government paperwork elimination and e-government acts of 2002.

The greatest growth in spending will occur in the government-to-business segment, as a result of a 260% increase in requested funding.¹⁰⁵ Software for e-government solutions will be the fastest growing segment, with the e-government software market growing from just over USD 680 million in 2004 to nearly USD 970 million in 2009 (7.3% pa).

Within the US market, noted ICT industry analysts and Government market experts INPUT corporation suggest that there are opportunities available for smaller subject experts, rather than large scale generalist integration firms.¹⁰⁶ It should be noted that US state governments also have large ICT budgets.

However, at the US state and local government level, INPUT reports that advances in 'Internet' government were beginning to slow down, with government to citizen services reaching a mature phase and suffering from some disillusionment in the effectiveness—resulting in a decline in spending from a peak in 2002 of USD 700 million to roughly 30% of that figure in 2004.¹⁰⁷

The United States is ranked first in the UN e-readiness rankings and second on the Accenture maturity rankings. Despite being a sophisticated user of e-government, it appears that more opportunities may exist at the state level. One possible opportunity for Australian security and encryption software firms lies in the area of e-authentication. The proposed federated e-authentication model will require leading edge technology. Australian security software firms should keep themselves apprised of developments in this area, as this is likely to set standards and drive innovation.

Western Europe

Western Europe is the most advanced e-government region outside North America. Growth in e-government expenditure among major European countries is expected to be strong.

Table 9. E-government spending in Europe (USDm)

<i>Year</i>	<i>2004</i>	<i>2008</i>	<i>Growth pa</i>
Germany	985	1,400	9.1%
France	980	1,300	7.3%
UK	828	1,200	9.7%
Italy	371	520	8.8%
Spain	200	300	10.6%

Source: IDC.

The United Kingdom has undertaken significant investment in IT improvements. According to Gartner, nearly GBP 12 billion was spent on technology by the UK government in 2003. The UK's E-government Unit reports to the Cabinet Office. Its e-government initiatives are well publicised, with a broad set of information links available from the main e-government portal allowing such things as searching for local schools, booking a driving test or making a complaint.

Despite some notable projects, such as centralised registration for e-government services and improvement to the main e-government portal to allow end-to-end transactions between agencies and customers, Accenture reported that the UK's progress had hit a plateau.¹⁰⁸ Nevertheless, the UK is ranked third in the UN e-readiness rankings and ninth in the Accenture maturity rankings. Given its level of sophistication and the potential for further improvement, the UK could be considered an attractive market for all types of Australian e-government software.

According to some critics, e-government in Germany got off to a slow start compared to other EU countries. E-government offerings in some cities, such as Bremen, Esslingen and Nuremberg, are trailblazers, but the rest of Germany's cities and towns remain behind on the information highway.¹⁰⁹

The German federal government has launched a nationwide consultation with enterprises aimed at collecting information to assist the development of e-government services for businesses. The analysis will inform the expansion of the federal portal BundOnline 2005, and bring greater focus on supporting businesses and entrepreneurs.¹¹⁰

The program seeks to streamline and integrate the 7000 portals and sites across all layers of government and to provide common infrastructure.¹¹¹ In 2004, Germany ranked 12th in the UN e-readiness rankings and 14th in the Accenture maturity rankings. Opportunities exist in the German market, especially for content management and other technologies that can assist in consolidating the multitude of online offerings into a more streamlined presence.

French e-government offerings now cover a wide range of services. France has had a successful and comprehensive online tax return filing service for several years, with more than 600,000 taxpayers filing their tax returns online in 2003.¹¹² The main gateway hosts two million visitors a month.¹¹³ In health, the SESAM-Vitale system facilitates claims placement to the patient's public health insurance centre. The French government is viewing e-government and open source software as a way to boost productivity and cut public spending.¹¹⁴

However, France also faces challenges in maximising return on e-government investment. It has a complex government administration structure, which has resulted in a proliferation of portals that are not integrated.¹¹⁵ The government has also set a priority to increase Internet usage, and this includes a program of broadband expansion.¹¹⁶ It has also announced an initiative to introduce electronic ID cards by 2006, which will carry identity information and an electronic signature allowing the holder to securely access e-government services.¹¹⁷

France ranks 24th in the UN e-readiness rankings and eighth in the Accenture maturity ranking. This discrepancy may be a result of some subjective analysis and the inclusion of additional countries in the Index. Despite these differing views as to the level of success France has achieved, it clearly has a desire to improve its position, so it will offer opportunities for Australian software.

The e-government software market

Accenture identified some of the most innovative practices in e-government. The table below summarises these practices and identifies the likely software segment involved. The major market segments are discussed below.

It is difficult to quantify the relative sizes of the three segments of the market: government-to-citizen, government-to-business and government-to-government. In any event, they could be expected to vary significantly from country to country and to be determined by policy. Singapore, for example, places a strong emphasis on business, hence its innovative business registration website.¹¹⁸ Other nations, like France, are focussed on cutting government operating cost and invest in G2C initiatives, such as online tax filing, to achieve internal government efficiencies.

Table 10. Market segment trends

<i>Sector of government</i>	<i>Innovations</i>	<i>Software category</i>
Revenue and customs	Bundling of services to provide a one stop shop Secure transactions Online and phone help	Development tools Content management Security software Customer relationship tools CRM
Postal	Bill presentation and payment Postal tracking Stamp printing from a PC Direct marketing for business	Trade and commerce software Specialist software
Human services	Job Search—resume creation Streamlining and bundling of entitlement information Integrated smartcards	Development tools Content management Smartcards and specialist software CRM
Immigration justice and security	Online claims and fines Secure document exchange	Payments and transaction processing Security software CRM
Cross industry services	Online business registration Mandatory business data collection Business assistance portals	Payments and transaction processing Security software Development tools Content management

Sources: Accenture and CIIER Analysis.

Basic infrastructure

A large number of e-government software applications are custom developments. Thus the infrastructure that supports them becomes a component in the e-government product system. This infrastructure includes operating systems, databases, application servers, and measurement tools. A noticeable feature in e-government is the prevalence of open source infrastructure software. In 2004, the United Nations reported that open source technologies played a significant role in almost half of government websites.

Opportunities may therefore exist for developers who base their applications on open source technology, especially for promotion to those governments who maintain a preference for open source as a means of fostering their local software industry.

Table 11. UN global e-government survey, 2004

<i>Operating system</i>	<i>Number of countries</i>	<i>% Total</i>
Linux/FreeBSD/open source	84	47%
Windows (98/NT/2000/2003)	64	36%
Solaris	23	13%
Other/Unix/Mac/not available	7	4%
Total countries	178	100%

<i>Web server</i>	<i>Number of countries</i>	<i>% Total</i>
Apache	91	51%
Microsoft IIS	58	33%
Netscape	8	4%
Lotus-Domino	4	2%
Other/not available	17	10%
Total countries	178	100%

Source: United Nations.

Worldwide, the relational database market grew by 12% to USD 15 billion in 2004. Oracle, Microsoft, IBM and Sybase account for 88% market share.¹¹⁹ It is a mature market and it is reasonable to expect that in the government sector the market shares of the large MNCs reflects the overall picture, leaving little opportunity for smaller competitors in this market.

The application deployment software market, consisting of application, web and integration servers, message oriented and transaction server middleware, adapters, connectors and gateways, is dominated by IBM, BEA Systems and Oracle. It grew 6.4% to USD 7 billion from 2003 to 2004.¹²⁰ This market is also maturing, with the three large vendors also experiencing increased competition from open source technologies, such as JBoss and JonAS.

Interestingly, in the US, a generally slow market in application servers has been offset by a large demand from government for the construction of e-government services.¹²¹ Overall, the entire infrastructure segment is dominated by large MNCs. Australian firms working in this area must rely on niche opportunities, or must seek to exploit the growing interest in open source technologies.

Table 12. Australian firms in the infrastructure segment

<i>Infrastructure</i>	
Rocksoft	Developers of data integrity and data management solutions.
Vision Gateway	Developers of Internet resource management products.

Source: CIIER Analysis.

Security

The security segment includes authentication, encryption technology and the use of smartcard technology. The global authentication market has seen sustained growth since September 11 2001. The Yankee Group predicted US market annual growth of 14% per annum, to USD 2.4 billion by 2008. Hence, authentication is one of the fastest growing segments of the government market. One player, RSA, accounts for 70% of the global market in this segment,¹²² and there is significant competition—from both large firms (e.g. IBM) and security specialists (e.g. RSA).

A noticeable trend is the move toward contactless smartcards. The US is said to be leading the way in the use of contactless smart chip technology, with MasterCard, Visa and American Express all launching contactless payment initiatives, as have major retailers, such as McDonald's, 7-Eleven and CVS.¹²³ Contactless smartcard technology also forms the basis of the new electronic passports initiative.¹²⁴

With the increasing focus on security, we can expect these types of government initiatives to increase. This has not gone unnoticed by the big MNCs, with Oracle and Intel joining forces to develop a 'common service-oriented enterprise framework' which is expected to provide the means to integrate the chip technology with Oracle's back-end software.¹²⁵

There are a number of Australian firms in this segment. Cards Etc are known to have provided services to the Victorian Government,¹²⁶ although the extent of use within government of their smartcard lifecycle management product, Arterium, is not known. Keycorp, a publicly listed Australia company with annual revenues in the order of \$100 million, had its smartcard technology selected for the Hong Kong Government's smart identity card system (SMARTICS).¹²⁷ Canberra based company Protocon develops single sign-on technology for distributed Internet applications, an ideal technology for e-government portal needs. Protocom was reported to be 'the leading global developer of host single sign-on software' in 2004.¹²⁸

Table 13. Australian firms in the security segment

<i>Security</i>	
Abacus Data Systems	Cryptographic key generators, secure mail, secure backup
Asrad	Internet security and administration products
b-Sec	Producers of firewall log incident analysis tools
Cards Etc	Smartcard management system
Ctam	Network security products
Eracom	Producers of transaction security hardware and cryptographic APIs
Keycorp Limited	Develops smartcard operating systems and applications, as well as smartcard readers and point of service payment terminals
GetData Pty Ltd	Security and data recovery
Protocon	Developers of authentication and security products
Senetas	Developers of security and encryption technology

Source: CIIER Analysis.

Specialist areas

This segment involves the provision of specific software for the various specialist services offered by government (e.g. land and mapping data, health and safety data). It is difficult to identify market data for specialist areas because there appears to be no comprehensive analysis or categorisation of the typical specialist needs of e-government.

We have attempted to examine just one of these areas, land and mapping data, within this chapter, whilst health software is addressed in more detail in the specific 'Health vertical' chapter in this report.

There are some notable projects in the geospatial applications area such as Saskatchewan's LAND project,¹²⁹ New Zealand's NZD 145 million Landonline project, and Victoria's AUD 71 million land titles administration project. In the Asian region, Malaysia is progressing developments in this area with the Ministry of Land creating the National Infrastructure for Land Information System (NaLIS) in 1997. Malaysia has also developed a portal dedicated to the geospatial industry.

The World Bank is promoting cadastral mapping in countries, including Cambodia, to formalise the mechanisms for land ownership and provide certainty and incentives for investment.¹³⁰ This will create an ongoing need for software and expertise in the region.

The high cost of some of these projects and the general unavailability of information about them suggests that land titles management is a relatively new area for

government, which offers potential to companies who can productise these types of application and offer them at a reasonable price.

The total market for GIS software in 2004 was AUD 1.3 billion, 9.3% up over the previous year. The public sector accounts for 19%. Competition in some areas of GIS is strong, with sophisticated players like ESRI and Intergraph accounting for 50% of revenue.¹³¹

Melbourne firm Geomatic Technologies offers an integration service called local government spatial solution (LGSS) which they have implemented in several local governments. It integrates technology from MNCs Autodesk, Macromedia and Oracle, to provide a geospatial mapping and asset system. Tasmanian firm Geometry also builds customised geospatial applications using base technology provided by MNCs.

Geometry has developed a number of projects for government, including the Northern Territory Department of Infrastructure, the Registrar Generals Office Canberra and Department of Urban Service ACT. Map Data Sciences, on the other hand, develops their own core technology and offers it as an ASP service. They have provided their technology to Victorian Tourism Online and the Australian Department of Environment and Heritage, among others.

Such examples indicate that the large MNCs, such as Autodesk, ESRI and Oracle, often provide the core technology in the geospatial segment, and Australian firms play an integration role for these products.

The apparently high cost of projects like the Victorian project and the New Zealand Land titles projects suggest that there may be a future opportunity for the creation of more standardised packages that successfully integrate the various technologies, and offer them in a 'productised' and more affordable form.

There may be value for Australian companies in this segment in conducting a more detailed market analysis to understand the full range of mapping applications needed by governments and to identify the areas of greatest opportunity.

Table 14. Australian firms in the specialist systems segment

<i>Specialist systems: geospatial</i>	
Geometry	Developers of geospatial information management systems
Geomatic Technologies	An Australian firm providing consulting and IT solution in geo-spatial asset management in rail and motorway infrastructure and local government
Lisasoft	An Australian firm developing GIS integrated software tools
Map Data Sciences	An Australian firm involved with geospatial software
<i>Specialist systems: departmental applications</i>	
Intaz	Developers and potential suppliers of health and safety advice related technology to government
Promadis	Developers of application specific e-government software including births, deaths and marriages
Versadev	Developers of software for e-government intranets, including Occupational Health & Safety applications, rostering systems and knowledge management solutions

Source: CIIER Analysis.

Customer relationship management systems (CRM)

Customer relationship systems maintain and record the history of an individual's or firm's communication with a government department or service, allowing call centre staff to assist the customer with future enquiries or to provide data to personalise an online presentation for that customer. Accenture confirmed an overall trend within e-government offerings to design the systems to be more 'customer centric'.¹³² This means a greater level of personalisation and customer focussed interaction.

However, the solutions are not as simple as purchasing CRM technology, because commercial CRM software is designed with very different goals in mind to the solutions needed by governments. 'Citizens are not prospects, and the objective of [government] CRM should be to enable and improve delivery of service, not to identify up-selling or cross-selling opportunity.'¹³³

Despite this, a German study suggests that the public sector is expected to represent one of the biggest areas of growth in CRM over the next few years.¹³⁴

Siebel, one of the world's largest providers of CRM solutions, provides CRM to the public sector in areas such as tax and revenue, homeland security, social services and so on. In the table above, we have identified two Australian firms offering CRM solutions, but do not currently provide solutions for government.

Given the potential growth in e-government focused CRM, and the likelihood of Australia governments adopting this technology in the future, it would seem that

Australian CRM producers should at least evaluate the e-government market as an area of potential opportunity.

Table 15. Australian firms in the CRM segment

<i>Customer relationship management</i>	
eImagine	Australian developers of commercially focused CRM systems
Prosper Business Solutions	Australian developers of CRM systems for the financial services industry

Source: CIIER Analysis.

Tools for constructing services

Tools for constructing custom e-government services include content management systems, payment gateways, development tools and rich web content creation tools.

The web development tools market is dominated by MNCs, such as Microsoft and Macromedia. According to Gartner, this market may come under some pressure as the development of custom software is increasingly becoming too big an investment for most companies, resulting in software as a service (SaaS) rapidly becoming a popular alternative for licensing software in SME markets.¹³⁵

How this will impact development work within the government market is not clear. Governments face both financial pressures to reduce the cost of their IT spend, and social pressures to reduce job losses from offshoring software development work. Some initiatives are also being explored, especially in local government, in the establishment of shared services models, and in Software as a Service (SaaS) delivery of software. These initiatives may also impact upon future software delivery, by consolidating requirements and creating critical mass for service delivery.

The payment gateway market, whilst important to governments, is addressed within the 'Trade and commerce' chapter of this report. While that analysis does not separate the private and the public sector's usage, we would expect the needs to be similar in both cases. There is little difference between the trends, opportunities and threats in the government sector and the private sector.

Content management systems are a way to reduce the web development overhead. Metagroup estimate that the worldwide content management software market, with major vendors including Interwoven, Open Text and Documentum, will be worth USD 2.3 billion by 2007.¹³⁶ A fragmented vendor market is expected to consolidate and create stronger competition in future.¹³⁷

Australia has good representation in content management software. Towersoft is a high-profile Australian firm in the content management segment, with a strong history of sales to government. This includes significant contracts in the US, UK, South Africa, Canada and Australia. Intology is a company with interesting meta-content tools for online systems, including ontology and taxonomy generators and auto summarisers. Intology has recently been acquired by the KAZ Group, which is itself part of Telstra.

Table 16. Australian firms in the tools segment

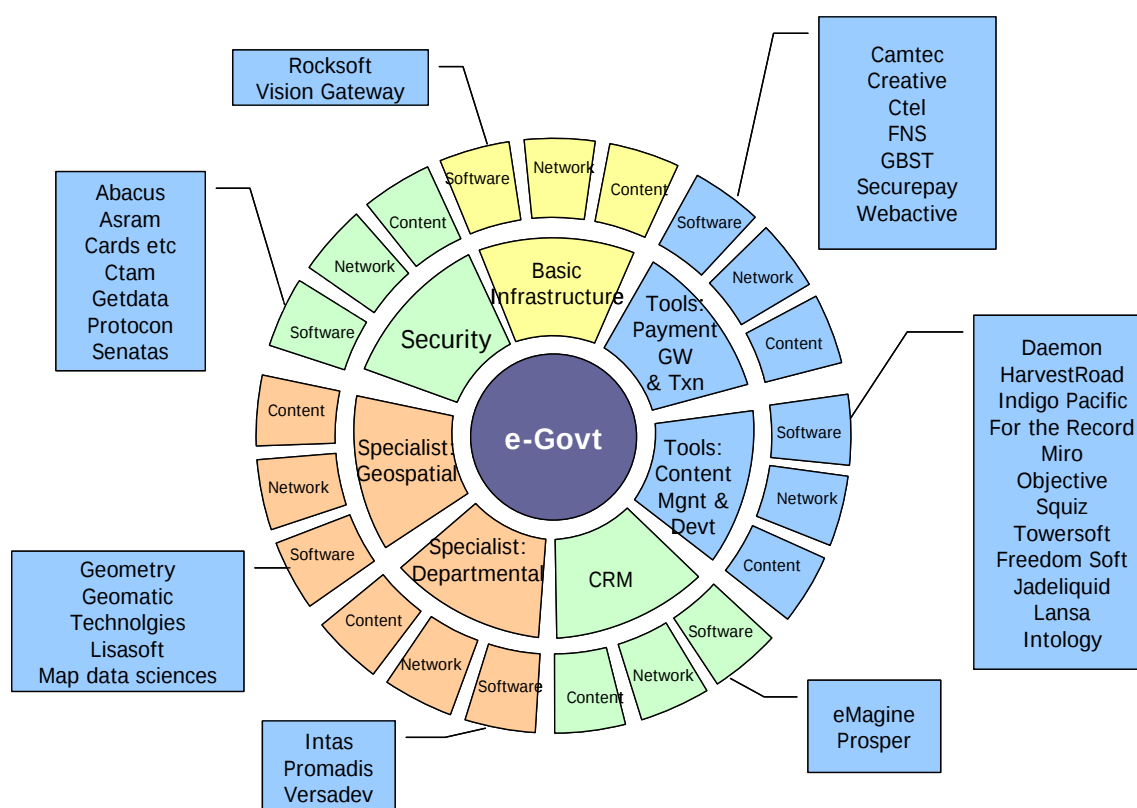
<i>Payment gateways and transaction systems</i>	
Camtech	Developers and operators of e-commerce payments gateways and merchant server software
Creative Digital Tech	Developers of payment gateway and associated software
Ctel	Developers of payments gateways, pay-by-phone, and Interactive voice response technologies
FNS	Developers of banking financial gateway products and other banking and treasury software
GBST Holdings	Developers of transaction technology for the financial services industry
Secure Pay	Providers of payment gateway technology and services for B2C (business to consumer) websites and other businesses
Web Active Corporation	Providers of payment gateway technology and services for B2C websites and other businesses
<i>Content management</i>	
Daemon	Developers of a free open source content management system known as FarCry
Harvestroad	Federated digital repository system
Indigo Pacific	Developers of website content management, electronic forms and workflow solutions
Intology(Kaz subsidiary)	Developers of meta-content tools for online systems, including ontology and taxonomy generators and auto summarisers
For the Record	Developers of multimedia recording and content management systems
Miro International Pty Ltd	Developers of open source content management systems
Objective	Developers of web content management and document lifecycle products
Squiz.Net	Developers of a free open source content management system called MySource Matrix
Towersoft	Developers of enterprise content management systems and email, process and records management solutions in the e-government market
<i>Development tools and rich web content tools</i>	
Freedom Soft	Developers of application development tools and web database front end products

Jadeliquid Software	Developers of products for delivering complex web content graphical displays
Lansa Software	Providers of software and tools for government portal construction

Source: CIIER Analysis.

E-government software suppliers

Figure 10. E-government vertical software market map



Source: CIIER Analysis.

The e-government vertical software market map shows the presence of Australian software firms in the various segments, and demonstrates that Australia has significant domestic strengths in several areas important for e-government—particularly in security and content management tools. However, Australia does not seem to have a substantial concentration of players in CRM, an important technology. CRM activity has been focused primarily on the commercial sector, but Australian CRM developers might consider participation in the public sector market in view of the potential for growth in this sector.

Innovation base and support infrastructure

There is little evidence of formal relationships between publicly funded research bodies and companies operating in the e-government software market, other than in the areas of security and geospatial applications.

Queensland has promoted an e-security cluster since 2001, when there were over 190 companies offering e-security products and services located there.¹³⁸ The Biometrics Institute (in Sydney) is a not-for-profit organisation for discussion about the use of biometrics for security. Its primary members are government and business (generally large corporations, such as airlines and banks) with other arrangements for vendors. A significant number of Australian companies are listed as technology suppliers.

The Cooperative Research Centre for Spatial Information (CRCSI) has several Australian companies that have developed geospatial applications for government use as members. Indeed, the CRCSI's current program includes a number of research projects with direct applicability to the future of cadastral and land mapping systems likely to be needed by government.¹³⁹

The Security and Privacy Group within the CSIRO's Department of Mathematical and Information Sciences has been looking at the problems of security for web services. It has proposed a consent based model of security which is being utilized by the Department of Health and Ageing.¹⁴⁰

Government market conclusions

There are several promising areas of growth for Australian software developers in the e-government vertical market. The three standout candidates are content management, security and geospatial technology. It is in these areas that the number of Australia players and the innovation base indicates a level of domestic capability and density of local expertise which improves the overall probability of success.

Australian governments should continue to take the opportunity to evaluate the local providers of content management tools when undertaking procurement for their e-government websites. There are good opportunities for content manager providers with developing countries (e.g. Malaysia) enthusiastically embracing e-government and the European countries (e.g. Germany) consolidating their e-government sites.

If they have not done so already, Australian security software firms might make a concerted attempt to become involved with the US government's security and authentications programs. The experience could stand them in good stead in other markets.

Applications that are government department specific will be difficult to commoditise, and they will always suffer longer sales cycles, with the market opportunities being harder to identify. Having said that, we anticipate that geospatial and cadastral e-government applications will become more important in the years ahead. However, the expense of such systems will, for the time being at least, make them of interest to only the most sophisticated governments.

Table 17. Overall SWOT for Australian e-government firms

Strengths	A good concentration of security software firms A good presence in content management software Good federal government support, supported by large state government projects in the geospatial software space A large number of Payment Gateway firms
Weaknesses	Not strong in basic infrastructure software CRM firms do not have a government focus Some aspects of the geospatial market are already dominated by MNCs
Opportunities	Opportunities for good sales in countries like Germany and France which are looking to consolidate their e-government offering to reduce government operating costs Opportunities in countries like Malaysia which are driving forward with their e-government offering Geospatial/land/cadastral applications are long lead time, big ticket items, but Australia is positioned well and should promote this area further to develop more local expertise The US e-authentication projects provide an opportunity for security software firms to understand the needs of one of the most demanding and sophisticated users of e-government
Threats	Competition from MNCs in most areas

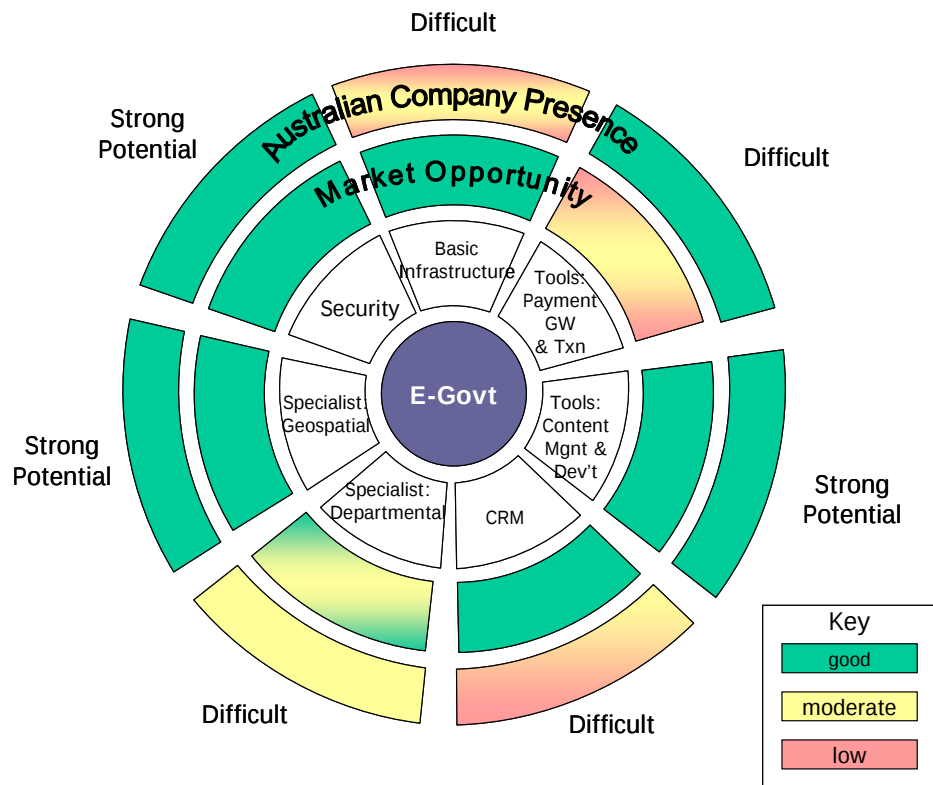
Source: CIIER Analysis.

The basic infrastructure and transaction tools segments do not include significant numbers of Australian developers. We suspect that this is because these areas are the most mature and are already well catered for by larger software firms. Despite the fact that they are growing, seeking a foothold in these segments will be difficult given the level of competition.

Although there is a strong Australian presence, the payment gateway segment is also a crowded market, and consequentially, Australian vendors should concentrate on value adding and differentiating. We would not be surprised to see some consolidation here in the future.

It is likely that CRM technology designed for use by government will be an area of increasing activity in the coming years. It does not appear that Australia has a strong presence in this market, and those firms that do participate are not focused on the government sector. We suggest that these firms may want to consider the e-government market in the future.

Figure 11. Market potential in e-government software



Source: CIIER Analysis.

Manufacturing

The manufacturing vertical market includes software to assist in the manufacture of a huge range of products, created by a similarly broad range of processes—both physical and chemical. Manufactured products range from aircraft to agricultural tools, and from medicines to flour.

The manufacturing vertical is best viewed as comprising many sub-verticals, or even micro-verticals; and each of these verticals will have its own requirements for software functionality. It is also helpful to distinguish between discrete manufacturing and process manufacturing,¹⁴¹ as ‘assembly line’ software can be quite different to other manufacturing related software, although these classifications are not precise.

Software is used by manufacturing businesses in a number of ways. Whereas there used to be a clear distinction between business management systems and process control within the sector, the boundaries are increasingly blurred. However, there are five main ways in which software is employed in this vertical.

- Enterprise wide systems which plan and monitor resources, control the supply chain, and integrate customer related information
- Manufacturing systems covering product lifecycle management, including CAD/CAM, and process management
- Programmable machines
- Monitoring and surveillance of staff and the workplace
- Incorporation of software into products and supporting services which are produced and delivered by manufacturing businesses

The manufacturing software product system

The largest category of software used in the manufacturing sector is that of enterprise resource planning (ERP) systems. These are comprehensive systems covering most business activities from order entry to shipping and from production forecasting to financial accounts.

The major manufacturing software vendors are predominantly European and US vendors such as SAP and Oracle. These businesses operate globally, with a network of local offices (generally subsidiaries) which support the product in the local territories.

The 10 largest ERP developers, ranked by global licence revenue, are:¹⁴²

Rank (2004)	Company	Revenue share (2004)	Revenue share forecast (2005)
1	SAP	40%	43%
2	PeopleSoft	12%	0%

3	Oracle (acquired PeopleSoft Dec 2004)	10%	19%
4	Sage Group	5%	6%
5	Microsoft Business Solutions	3%	4%
6	SSA Global	3%	3%
7	Geac	2%	2%
8	Intentia	2%	2%
9	Infor Global Solutions	2%	2%
10	Lawson	2%	1%

Two Australian-grown enterprises have significant international presence, Mincom and Bowen & Groves. Mincom is strongly focused on ERP solutions for the mining and other asset-intensive sectors, with significant clients overseas; while Bowen & Groves specialises in the important SME marketplace.

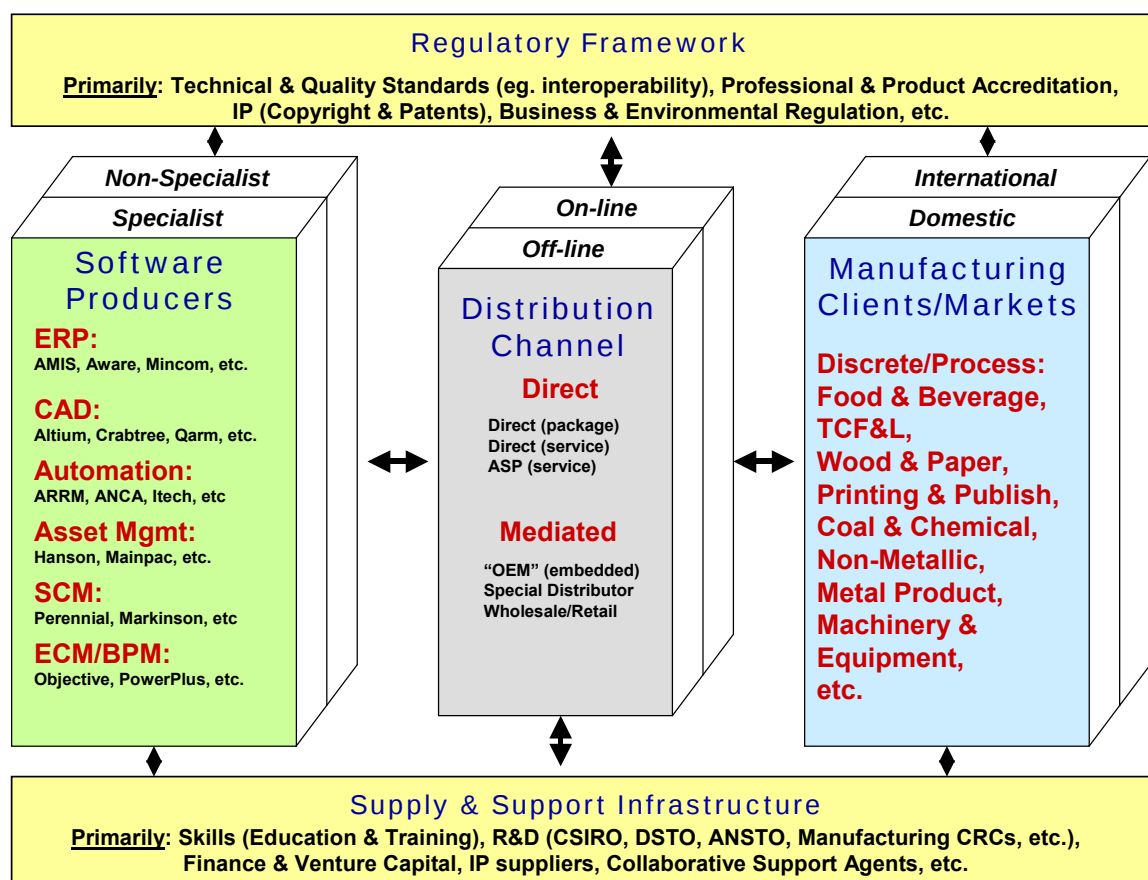


Figure 12. The manufacturing software product system

Source: CSES Analysis.

While there are fewer relationships between ERP vendors than there are in other software sectors, it is an area where industry consolidation is a constant driver, as big vendors acquire other major players and attempt to consolidate the combined product set. Oracle's acquisition of PeopleSoft is a recent example.

Increasing fixed costs are driving continued restructuring and consolidation throughout the ICT industry, whether through internal restructuring, outsourcing of sub-scale activities, or mergers and acquisitions. The potential impact of such consolidations touches the over-arching concern for enterprises investing in mission-critical software—will the software continue to be supported?

The issue is broader than simply 'will the developer continue to be commercially viable?'—a successful developer may be bought out by, or merge with, a competitor with subsequent rationalisation of the product range. Even large developers are not immune to this.

Enterprises make a significant investment in ERP and manufacturing systems and often, they stake their competitive edge on successful implementation.¹⁴³ Therefore, it is not surprising that they have a strong loyalty to their provider and expect this to be returned. Strong communities of practice have developed around ERP products. For instance, well attended technical and business conferences are regularly convened for each of the major applications.

The major vendors have global coverage and are able to reach and support clients in most markets. The smaller players, often lacking such coverage, are essentially limited to their own geographical (rather than sector) markets. However some unconventional initiatives can achieve the same outcome.

The Australian 'smart car' concept is an example of such an initiative, where promotion of a manufacturing concept incorporating many Australian technologies, including ICT, has allowed global reach into this particular sub-vertical. Such initiatives can capture the attention of overseas customers and open the door for Australian vendors.

Within the increasingly important SME market, Microsoft and SAP are putting greater emphasis on providing tailored ERP products.

On the 'demand' side, the market is growing as smaller manufacturing businesses try to compete with large ERP equipped enterprises. In this active arena, supplier SMEs are often small enough to do 'something different' and are able to focus on the quality of the implementation more than the product itself—creating an opportunity for good implementation support.

Box 14. Example of a niche application—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 turnkey 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: Houghton, J.W. *et al.* (2005) *Australian electronics industry capability mapping report*, June 2005, DITR & Invest Australia, Canberra.

In the specialist areas, the story is a little different. Computer aided design (CAD), supervisory control and data acquisition (SCADA) and programmable logic controllers (PLC) are typical of specialist products where the market has particular characteristics. In these areas, there are a very small number of globally recognised products and providers, and some local players who, by providing specialist add-ins for narrow niches, are able to sell their products globally.

Some clients in the manufacturing product system are large-scale global businesses, but many are smaller locally and regionally focused firms. Given the potential importance of a focus on SMEs and tailoring systems and solutions in sub- or micro-verticals within manufacturing, developing close working relationships with clients locally is an essential springboard into wider markets. Industry, technology and domain specific expertise will also be essential, with developer demands for a mix of technical ICT and domain specific business and technology skills.

Global restructuring in the manufacturing sector has many implications, including: the potential reduction in the number of customers through consolidation; much greater focus on supply chain management and deep integration of supply chain processes and other business functions; and much greater emphasis on standards and interoperability. As noted, there are potentially significant choices to be made in channel partnering, and great care will be needed in the choice of channel partners and paths to market.

Key innovation drivers include having sector-specific knowledge and expertise, and strong and ongoing innovation capabilities. Credibility may require formation of alliances or other partnering arrangements in order to present a vendor organisation of suitable industrial ‘weight’. In Australia there are a number of R&D support partners with specific domain expertise and potentially commercialisable software, with whom innovation and development linkages might be beneficial.

The manufacturing market

Of the USD 319 billion (AUD 420 billion) which the manufacturing sector spends on ICT each year worldwide, approximately 16% (USD 50 billion or AUD 66 billion) is spent on software.

In Australia, total ICT expenditure by manufacturing enterprises in 2003 was estimated at USD 2.8 billion (AUD 3.7 billion). This represented around 8.9% of Australia's total spend on ICT, which in turn represented around 1.3% of ICT spend worldwide.¹⁴⁴

Estimated expenditure on software by Australia's manufacturing sector was USD 532 million (AUD 700 million) in 2003.¹⁴⁵

Table 18. Manufacturing industry ICT expenditures, 2003 (USD billion)

	USD billion	Share of expenditure
Australia		
Manufacturing	2.8	8.9%
Total (all sectors)	31.0	100.0%
Worldwide		
Manufacturing	318.8	13.3%
Total (all sectors)	2,392.8	100.0%

According to WITSA, the Australian manufacturing industry's expenditure on software grew bySource: WITSA biennial study, 'Digital Planet: the Global Information Economy', by the Worldwide Information Technology and Services Alliance ('WITSA'), published October 2004.

The Australian manufacturing industry's expenditure software grew by nearly 9% in the period 2003–2004, but this growth rate is projected to lessen in the following year, especially in the processing subsector.

Table 19. Australian manufacturing software expenditures (USD million)

	2003	2004	2005
Manufacturing (total)	532	579	613
Discrete manufacturing	363	394	419
Process manufacturing	169	185	194

Source: WITSA biennial study, 'Digital Planet: the Global Information Economy', by the Worldwide Information Technology and Services Alliance ('WITSA'), published October 2004.

The global market for ICT (hardware, software, services and telecommunications) is projected to grow at 8% pa between 2003 and 2007, reaching USD 3.2 trillion (AUD 4.2 trillion) in 2007. Over the same period, the global manufacturing sector's projected increase in expenditure on all categories of ICT is 7% pa.

For comparison, the Australian manufacturing sector's projected increase in ICT spend is 5.3% pa over the same period.

Table 20. Regional per annum growth in ICT expenditure (all sectors)

	<i>Eastern Europe</i>	<i>Asia– Pacific</i>	<i>Africa</i>	<i>Western Europe</i>	<i>Middle East</i>	<i>Latin America</i>	<i>North America</i>
1999–03	16 %	3 %	8 %	5 %	6 %	3 %	4 %
2003–07 (projected)	12 %	9 %	9 %	9 %	8 %	7 %	7 %

Source: WITSA biennial study, 'Digital Planet: the Global Information Economy', by the Worldwide Information Technology and Services Alliance ('WITSA'), published October 2004.

Within Asia, projections for the annual rate of growth of ICT spend over this period include: China 13.9%, South Korea 11.4%, and India 13.4%. According to the North American market research firm, Global Insight, the spending on global sourcing of computer software and services will grow at a compounded annual rate of 26%, jumping from USD 10 billion (AUD 13 billion) in 2003 to USD 31 billion (AUD 41 billion) by 2008.¹⁴⁶

By any measure, Australia's manufacturing sector is not a heavyweight player in terms of its aggregate spending on ICT.

Table 21. Manufacturing sector ICT expenditure, 2005 (USDm)

<i>Expend</i>	<i>Eastern Europe</i>	<i>Asia- Pacific</i>	<i>Africa</i>	<i>Western Europe</i>	<i>Middle East</i>	<i>Latin America</i>	<i>North America</i>
USDm	9,055	144,421	2,757	92,455	1,897	9,253	115,823

Source: Global Insights 2004.

Business issues and their impact on the manufacturing software market

Globalisation

One of the most significant issues in the manufacturing sector worldwide is globalisation—in relation to supply chains, labour and skills, distribution channels and markets. For those in the developed world, the issue relates especially to the low cost labour economies in Asia and Eastern Europe.

World Bank figures¹⁴⁷ show that manufacturing as a share of gross domestic product (GDP) fell by about 2% to a typical level of 20% during the 1990s in the wealthiest nations. However, in the Asian countries around the Pacific rim, manufacturing as a share of GDP rose during the same period by 4%, to a typical level of 32%. Asian manufacturers are focused on moving up the value chain, to embrace the design phase which represents a growth market for offerings such as product lifecycle management.

Productivity tools

There are some impediments to sales growth for manufacturing software, especially ERP solutions.

- Market saturation in their traditional sectors, with most larger firms having already implemented a range of enterprise applications

- Capital budgets of larger enterprises are now shrinking
- CIOs are now pushing for a strong return on ICT investment

These pressures are resulting in aggressive moves to win clients from competitors.¹⁴⁸

Nevertheless, there are some significant opportunities. Businesses linkages, whether through merger and acquisition activity or through a less formal partnering arrangement, create opportunities for closer ICT integration and increased productivity. Frequently, new applications software is implemented by one or both parties. ERP suppliers are a notable beneficiary of such integration activity, given the potential for providing an integrated view of information to support decision-making. ERPs are also being adopted to improve business processes and enable operational efficiencies.

Globalisation, environmental and regulatory concerns are driving the uptake of applications such as: supply chain management (SCM)¹⁴⁹ and product lifecycle management (PLM).¹⁵⁰ The latter offers, amongst other benefits, the potential to reduce time-to-market through better collaboration in the design phase.

Sector-specific issues

Many issues are specific to individual manufacturing sectors and the impact on similar businesses in different parts of the world often varies. For example, manufacturers of renewable energy equipment can be strongly affected by national policies on environmental issues and energy usage.

Energy prices are of particular importance to energy-intensive manufacturing sectors such as glass and steel making. The issue of rising energy prices has not been of critical importance to most manufacturers, though more recent uncertainties surrounding the supply (and consequent steep price rises) may have raised its importance. Rising prices impact on the cost of transporting goods or materials and this may have major repercussions in supply chain management and influence the design of global supply chains.

Integration

Capgemini has reported seeing a trend for manufacturers to move ‘from what was once the role of a traditional manufacturer to a more complex, higher-value role of integrator, bringing sub-contracted development, assembly and sales together, often dealing with multiple distribution channels. To succeed, ‘...firms must now marry their supply chains with manufacturing processes, sales and logistics, procurement, regulatory environment, human resources and back office functions.’¹⁵¹ As a result, manufacturing is blending with other industry sectors. Technologies, products and services are merging, as the following scenario exemplifies.

Capgemini suggest that, rather than purchasing a new domestic washing-machine outright, the contract may become one of pay-per-use. The contract would involve the manufacturer and the utilities including water, electricity, gas, telephone and Internet—the latter to allow continuous monitoring. The user pays a single use-related amount, covering the basic cost of the machine, operational (utilities) costs, product upgrades,

advanced energy-efficient technologies, maintenance/ repair costs and recycling costs on disposal.

For the white-goods manufacturer, ICT provides the enabling technology allowing enhanced usability features, energy savings and monitoring capability to be offered in an increasingly competitive global market. The example could have parallels in the automotive and other sectors.¹⁵²

Advances in ICT will also support the integration trend by enabling componentisation of service delivery. According to the Foresighting Working Group report:¹⁵³

Componentisation of service delivery will provide an opportunity for the creation of the ‘off-the-shelf’ networked components capable of easy amalgamation. Australia has strengths in specialist areas that can be built upon, for example, in informatics (complex processing tasks such as in finance applications and share registries), ICT based games, bioinformatics, health applications, education applications and e-security.

Outsourcing to specialist suppliers

There is intense focus on aligning ICT with business goals, leading to more outsourcing as firms continue to reduce their ICT budgets and reduce internal ICT staff-count.

IDC recently issued what they called a ‘call to action for ICT suppliers that have not made the transition to verticals’;¹⁵⁴ suggesting that software vendors whose products have a broad industry focus will lose out to those who move to align their products with the specific needs of chosen client industry vertical markets. The specialisation message is echoed by others. A McKinsey report suggested that:

...as ICT becomes increasingly central to business processes of many firms, enterprises are demanding higher levels of specialisation and greater transparency around their return on ICT investments. ...Globally-oriented specialists are likely to play an increasingly important role in the industry. These specialists who maintain focus on a specific function and/or end-user segment, particularly in software, are likely to be successful, particularly if they focus on ‘white space’ where MNCs are not, as yet, well entrenched. Increasingly, they will need to be global or at least regional to survive.¹⁵⁵

Traceability and auditability

An ever-growing body of legislation is imposing new requirements across a range of areas including corporate governance (e.g. the US Sarbanes-Oxley legislation), environmental impact, occupational health and safety, and after-sales care. This translates to a growing need across all sectors for auditability and traceability. For example, it impacts on governments in the consultation process when selecting the route for a new road, as well as industry and in the health sector it dictates the need to be able to trace pharmaceuticals throughout their development and manufacturing process.

ICT trends, issues and technologies

The relevance of ICT trends and technologies varies from one manufacturing industry to another and this section explores some developments which appear likely to have a significant impact on this vertical.

Radio frequency identification (RFID) tags are touted as the successors to bar-codes, in much the same way as smartcards are predicted to replace magnetic-strip cards. Attached to an item, the tags carry data relating to identification, location and other information. This data can be updated and can be interrogated by a non-contacting reader. RFID tags will allow life-of-the-product tracking and more in-depth data histories, and may result in more market efficiencies. Sensors could be embedded in perishable product shipments, monitoring temperature, vibration, spoilage and other factors as the goods move from transport to warehouse to store shelves.

RFID promises improvements to the supply chain through improved track-ability and traceability. It can also reduce misdirection and loss of parts and goods, while increasing the accuracy of parts supply and simultaneously reducing labour costs and elapsed time devoted to goods/stock tracking. In some sectors, its potential to improve make-to-order capability is also valuable.¹⁵⁶

The current strong US interest in RFID may be heightened by legislation, and by mandates issued by major corporations and US defence agencies, rather than to proven business benefits.¹⁵⁷

‘Software as a service’ (SaaS), is one of the approaches used within the application service provider (ASP) model, ASP refers to various mechanisms for using hosted applications over the Internet. The adoption of service approaches and solutions is one of the fastest growing trends in ICT.¹⁵⁸ The model is not new, but as technologies improve and high-speed Internet access becomes more prevalent among SMEs, it is increasingly attractive because it is flexible and offers predictable pricing.

By virtue of this flexibility, ERPs that are unaffordable to smaller firms are brought within reach by the ASP model (e.g. the airframe suite of programs, at www.myairframe.com). In the ERP domain, SAP, Oracle and Microsoft are champions of the ASP model. Note, however, that in some regions the available infrastructure limits uptake of ASP services because of its requirement for high-speed Internet access.

Box 15. Airframe—an example of the SaaS model

Airframe offers small businesses a large selection of business management software over the Internet. Unusually, pricing is on a per-user rather than a per application basis. In part, this recognises that in small businesses a single user may handle multiple functions and thus need to use multiple applications. It also recognises that small businesses want to implement a suite of applications progressively, starting with the ones which address the most pressing issues. Gradually, when the business is ready for the next step, further applications can be added.

The range of business functions accommodated in the Airframe suite is broad. The applications are grouped into five main categories: My airframe, customer relationships, employee services, operational and site services.

Further information: www.myairframe.com

The SMEs (of whom a substantial number are in the manufacturing sector) targeted by SaaS providers, could be viewed as a sub-market. But SMEs are also important strategically because of their growth potential; the SaaS model enables software providers to engage with smaller companies and offer satisfied customers a continuous growth path without the risks and disruption of changing software platforms.

The appeal of **Web Services** (i.e. the services, standards and protocols that enable systems and applications to interact) is the potential to simplify communications across applications and their databases. It may reduce the barriers to entry for specialist providers. Using the term ‘shared Internet protocol networks’ in place of web Services McKinsey note that:

The emergence of Shared Internet Protocol Networks is resulting in a disentanglement of many functions from the underlying infrastructure, meaning that many services or functions can now be delivered discretely and remotely. This drives new specialist opportunities in areas that could previously only be delivered by large players with wide capabilities.¹⁵⁹

As for many technologies, the existence of an incumbent technology means that the impact will not be immediate in markets already well-penetrated, but the take-up in newer and growing markets may well be more rapid.

E-commerce /e-manufacturing encompasses the contributions of Internet-based trade and/or business interaction with external parties. E-manufacturing offers such benefits as improved speed of response, cost savings, improved communications, information and knowledge sharing, reductions in inventory, improved efficiency and productivity, harmonisation and standardisation of procedures, faster transfer of best practices, acquisition of new customers and increased sales, and improved customer service.

E-manufacturing is particularly potent when combined with wireless technologies, which offer ubiquitous computing between disparate devices. The applications to manufacturing businesses generally include voice and messaging, hand-held and

Internet-enabled devices, and data networking (specifically wireless LANs, broadband wireless and Bluetooth).

For the manufacture of highly customised goods, wireless technologies bring the exciting possibility of an ‘agile, wireless manufacturing environment’, offering rapid and adaptive production. Information (e.g. activities status, resource availabilities, design and scheduling changes) can be sent to and received from every employee/contractor or process, regardless of their location. Workloads may be constantly adjusted to achieve peak performance. Dynamic scheduling becomes possible, with real-time information on task status, resource availabilities, and job priorities being considered ‘on the fly’ to determine an operator’s next task.

The manufacturing software market

Software designed for manufacturing enterprises, can be categorised based on the enterprise’s underlying business processes and business ‘logics’. Such a classification has been developed by Professor Eric Giertz, of Stockholm’s University of Technology. His classification included 21 ‘business logics’.¹⁶⁰ Larger, more complex organisations may embrace more than one ‘logic’, and firms may be in different industries but their core processes may share a common logic. For example, printing works and machine shops share the ‘contract manufacturing’ logic, while ‘newspaper printing’ is grouped with ‘steel mills’ in the ‘capital intensive processing’ logic.

Similarities in business logic can be expected to be reflected in user requirements for business applications software. The insight provided by Giertz’ classification is that software may be suited to other industries sharing the same logic as the industry for which it was designed; conversely, the software is likely to require considerable modification for industries with a different logic. This approach therefore allows potential or promising markets to be identified for a given software product.

Table 22. The 21 business logics

Raw material production	Retailing	Rental services
Contract manufacturing	Administration institutions	Teaching services
Labour intensive	Institutional service	Distance support
Processing	Utilities	Artistry
Capital intensive	Manual services	Contracting
Processing	Knowledge intensive	Duplicating
Assembling	Services	Brokering
Transporting	Local service	
Trans-shipping	Establishments	

Source: Giertz, E. (2000) *Measuring Success: Identifying Performance Indicators*, Celemi Publishing Inc.

TLAs (three-letter acronyms) in manufacture

Manufacture seems to be addicted to three-letter acronyms for its processes, and thus the software that supports them. While the letters may change, many of the processes do not.

Box 16. The relationship between MRP, MRP II, ERP and APS

Manufacturing software systems have evolved in functionality over the years. The early systems were designated MRP (manufacturing resource planning) systems. MRP systems had basic functionality for inventory control, bill of material processing and elementary scheduling. As more scheduling functionality was added, newer software generations were called MRP II. (MRP = material requirements planning; MRPII = manufacturing resource planning, requiring—as does ERP—addition of a master production schedule).

MRP II systems were then replaced by ERP (enterprise resource planning) systems which added more applications like order processing, project management, maintenance and human resources. Today no manufacturing software vendor would designate their system as anything less than an ERP system.

APS (advanced planning and scheduling) systems added more functionality again. An APS program includes the ability to optimise shop floor and supply chain scheduling. The program determines the best schedule given the multiple constraints of labour, material and equipment. Some ERP products include APS features. There are also separate APS products that integrate with existing ERP solutions.

Adapted from: Seradex Manufacturing Software,
www.seradex.com/FAQ_ERP/ERP_MRP_Differences.shtml

A ‘basic’ ERP typically comprises suites of modules in five categories: human resources, enterprise asset management (EAM), supply chain management (SCM), financials, and customer relationship management (CRM).

Many factors affect the functionality required from an ERP. The first important distinction is between *discrete* and *process* manufacturing. System elements may then include design, manufacture, sub-contract, purchase, assemble, test, install, commission, upgrade, retail sales, and after-market sales. Some businesses make-to-order while others make-to-forecast, and may have a one-off, batch or continuous production arrangement. Workload forecasting and control may be based on backward scheduling or forward scheduling, and assume finite or infinite capacity. Traceability at the part level may be important, as in Defence contracts, or irrelevant. Even the lead-time of orders can be important, as this impacts allowable accounting treatment. Enterprise size and production volumes are further factors impacting the functionality required.

Therefore, while ERP packages are acquired by businesses in all the subsectors of the vertical, this is only possible because of the wide range of functionality built into these applications.

Table 23. A ‘basic’ enterprise resource planning (ERP) system

Human resources Benefits management Recruitment management Personnel management Payroll Payroll reporting Enterprise asset management (EAM) Asset management. Work management. Procurement. Materials management. Supply chain management (SCM) Supply chain reporting & analytics. Service parts planning. Resolution management. Inventory optimisation. Advanced production scheduling. Supply chain planning. Shipment planning & management. Replenishment planning & scheduling. Material requirements planning (MRP). Master production scheduling. Inventory management. Enterprise-wide planning. Demand planning. DRP & distribution network planning. Customer planning/shipment scheduling. Capacity requirements planning (CRP).	Financials Accounts payable General ledger Fixed assets Financial reporting & analytics Cost accounting & management Cash management Budgeting Accounts receivable & credit management Customer relationship management (CRM) Partner relationship management. Quote & order management. Warranty & returns management. Sales incentives & compensation. Sales forecasting & planning. Sales configuration. Pricing & contract management. Opportunity management. Multi-channel fulfilment & service. Market strategy & brand management. Field service management. Deal & promotions management. Contact & account management. Campaign management. Call centre & customer service. CRM lytics. <i>Also: document mgt, content mgt, business intelligence and business process modelling</i>
---	--

Source: Managing Automation website, www.managingautomation.com, CIIER Analysis.

Historically, manufacturing firms comprised many islands of automation—purchasing, production control, stock control and so on. In some instances the ‘islands’ were packages, and in other instances they were custom-developed solutions. The logical step of linking the ‘islands’ was taken either by a systems integration route or by creating a new ‘super-package’, the ERP. The implementation teams of ERP developers found that in some sectors they could reuse the work they had done tailoring a solution for one client, by promoting it as ‘best practice’ to other potential clients in the sector.

Nevertheless, there remain a number of specialised industry sectors for which no complete ERP solution exists, particularly where enterprises are smaller than the multinationals that dominate the automotive and other sectors. For example, the aquaculture sector is one with a unique combination of processes and practices; it is unlikely that any established ERP would prove a very satisfactory match without significant customisation. The pragmatic solution frequently involves integrating modules from multiple developers. This represents an opportunity for implementation specialists and systems integrators rather than developers.

The scope of ERP offerings is changing. Functionality which was considered specialist at one time, may later be viewed as integral (examples of this include customer relationship management and supply chain management which are now core ERP elements). This fluidity in the ERP concept means that the match between an offering and the needs of a business or business sector is also in a continuous state of flux; it also presents opportunities for additional modules/functions, as described in the following paragraphs.

Non-ERP software

Software relevant to the manufacturing vertical but not included within the ERP category falls into one of two categories:

- *Additional modules/functions*—functionality which many manufacturing enterprise would require for efficient monitoring and control of operations (e.g. product lifecycle management); and
- *Specialist applications*—functionality which relates to aspects of an enterprise's activities which are relatively unique or unusual (e.g. an expert system to help operators optimise a production line's set-up).

The boundaries are a little blurred. Computer-aided design (CAD) is an example of an application which could fit either category, but fits neither very well. Although part of reasonably generic manufacturing operations, it is also a specialist application fundamental to the design function. Furthermore, the selection of CAD tools—and a range of add-ons for computational fluid dynamics, finite element analysis and other needs—is invariably undertaken by the design/manufacturing specialists in a manufacturing company rather than by those concerned with broader ERP matters. The table below provides an indicative list of the *additional modules/functions* which may currently be regarded as required for an ERP intended for the manufacturing sector. The list is far from definitive, with new capabilities continually evolving.

A further module, which could be regarded either as a further module within the 'Manufacturers' ERP' category, or as a specialist application, relates to re-manufacturing. At least one developer has created software specifically for the unique and demanding needs of re-manufacturers in several segments of the industry.¹⁶¹ The product line includes core banking, tracking, re-manufacturing planning and execution functionality.

Table 24. Additional modules relevant to the manufacturing vertical

Manufacturing execution systems (MES) Operator interface Quality management Process control Supervisory control Manufacturing process management Operations performance management	Manufacturing Materials management Batch process reporting Production scheduling Production reporting Production order management Plant floor data collection Lot & serial reporting Lean manufacturing Labour reporting Kitting & kit processing
Product lifecycle management (PLM) Computer aided design (CAD) Project, program & portfolio management Production & event simulation Product variant configuration Product lifecycle collaboration Product data management Formulation Engineering change & configuration Management Electronic data vaulting Computer aided manufacturing (CAM) Computer aided engineering (CAE) Computer aided process planning (CAPP)	Supply chain execution (SCE) Warehouse management reporting Warehouse inventory management Warehousing pick, pack & ship Warehouse receiving & put-away Warehouse management: reporting/ analysis Warehouse management: international trade management
Quality management Non-conformance and corrective action Statistical analysis/techniques Quality system interfaces Quality documentation Product handling and servicing Laboratory information management Inspection and testing Hazardous material reporting Cost of quality	Supplier relationship management (SRM) Exchange-marketplace procurement Strategic sourcing Purchasing Procurement reporting & supplier Performance Procurement receipt & inspection Partner collaboration
	Additional units within: enterprise asset management (EAM) Condition monitoring Inspection scheduling and management

Source: CIIER Analysis.

The range of specialist applications is enormous, and continually evolving. In many instances these applications target industry micro-niches. For example, one specialist application targeting a micro-niche is an expert system¹⁶² which guides users in the demanding and complex science of electro-plating. Other applications target broader niches; process industries such as water utilities, food manufacturing and bulk chemicals manufacturing are sectors in which distributed control systems are a key application. The table below provides a sample of *specialist applications* relevant to the manufacturing vertical.

Table 25. Specialist applications relevant to the manufacturing vertical

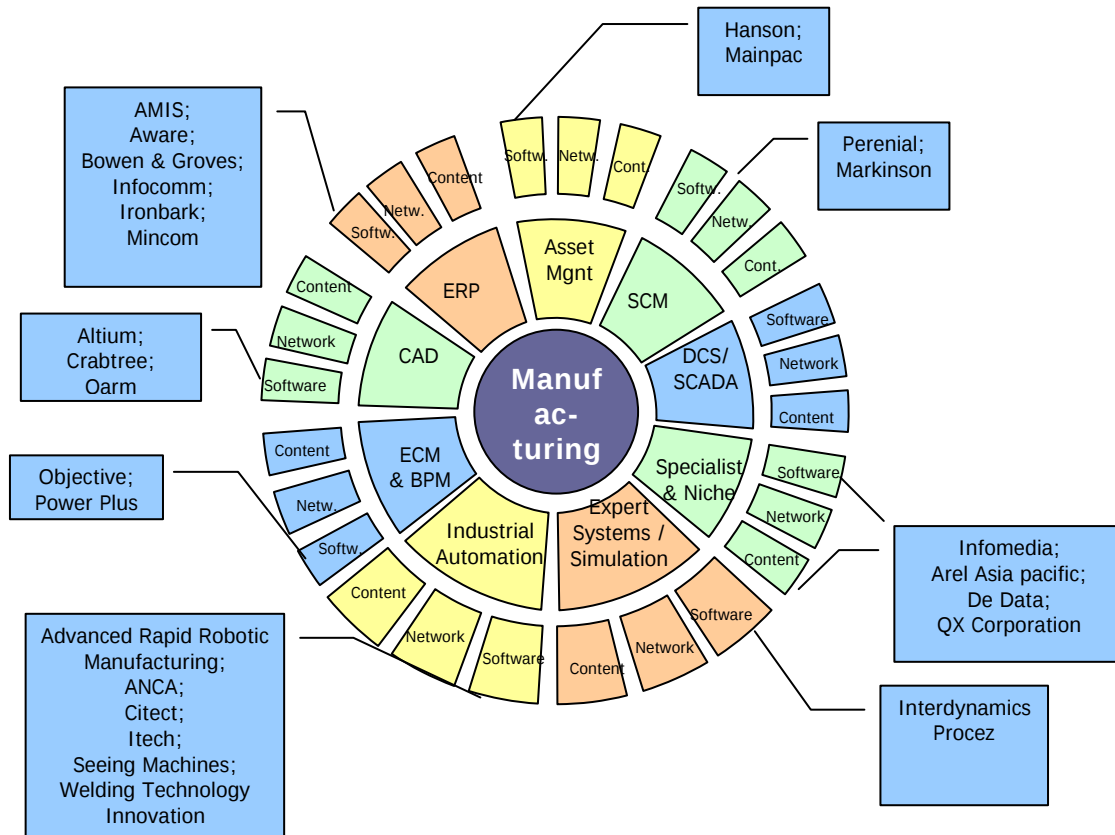
Software relate to control of equipment and production systems Distributed control systems (DCS) (inc. MMI/HMI/SCADA) ¹⁶³ Programmable logic controllers (PLC) and Programmable automation controllers (PAC) ¹⁶⁴ Machine vision Robotics & mechanical arms Machine tool controls – CNC/DNC Motors, drives (incl. DC Servo) and transmissions Data acquisition & data capture Instrumentation & measurement Fault diagnosis Stock-cutting and sheet-layout optimisation	Software related to design Computer aided design (CAD) Add-ins for CAD – e.g. FEA, CFD, surface-modelling PCB and circuit design Simulation Engineering/scientific modelling Software related to expertise Decision support Artificial intelligence/fuzzy logic Expert systems, e.g. electro-plating ¹⁶⁵ Other software Regulatory Compliance (environmental, safety, international regulations) Plant lay-out, simulation, line-balancing Position-finding software (e.g. Locata) ¹⁶⁶ Automotive software (e.g. adaptive cruise control and reversing-aid radar)
---	--

Source: CIIER Analysis.

Manufacturing software suppliers

The manufacturing vertical software market map indicates some of the main areas of activity and strength, together with a few of the firms operating in the various vertical market segments.

Figure 13. Manufacturing vertical software market map



Source: CIER Analysis.

Notes: SCM: Supply Chain Management; FMCG: Fast Moving Consumer Goods; ECM: Enterprise Content Management; BPM: Business Process Modelling; CAD: Computer Aided Design; ERP: Enterprise Resource Planning; MES: Manufacturing Execution Systems; PLM: Product Lifecycle Management; SCE: Supply Chain Execution; DCS: Distributed Control Systems; SCADA: Supervisory Control and Data Acquisition.

The following table shows a selection of Australian firms engaged in software development targeting the manufacturing vertical market. The list does not include firms which are mainly overseas software distributors, or which are owned by overseas entities.

Table 26. Australian software firms in the manufacturing vertical market

Advanced Rapid Robotic Manufacturing	Advanced rapid robotic manufacturing (ARRM) specialises in innovative automation of complex, labour intensive sample preparation in analytical, research and quality assurance laboratories worldwide. This involves engineering for high speed robotics and specialised software programming (from firmware through to GUI). Automation and robotics—especially pharmaceutical manufacturers.
Advanced Systems Integration Pty Ltd	Advanced Systems Integration (ASI) specialises in the design, manufacture and implementation of integrated electrical, electronic and computer based systems for the mining and heavy industry sectors. ASI provides solutions in SCADA design and implementation, telemetry systems, engineering design services and PLC design and programming. SCADA systems—heavy manufacturing.
Altium Limited	Altium Limited is a leading global developer and supplier of electronics design software for the Microsoft Windows environment. Founded in 1985, Altium released the world's first Microsoft Windows-based printed circuit board design tool in 1991 and continues to provide advanced, easy-to-use and affordable software design tools to electronics engineers, designers, and developers worldwide. Altium's products offer tailored solutions covering a range of hardware and software design processes. Design software—electronics and printed circuit board.
AMIS Software	AMIS is a complete, integrated software package for manufacturing, distribution & accounting, running on Windows. AMIS assists in the Planning and Control required in manufacturing & distribution environments. Mini-ERP—SMEs.
ANCA Pty Ltd	ANCA is a major supplier of precision grinding machines with high technology CNC controls to the world's leading metal based manufacturing firms in the cutting tool and precision component industries. ANCA is an industry partner of the CRC for intelligent manufacturing systems and technologies. Machine tool controls.
Arel Asia-Pacific Pty Ltd	Arel is a leading solution provider for textile manufacturers across Asia, Africa and Europe, providing both hardware and software based solutions for manufacturing, warehousing and distribution of all types of textile and garment products. Manufacturing and distribution software—textile and garment manufacturers.
Assured Systems (trading name of Ledward Pty Ltd)	The finite capacity loader and interactive rescheduler ('FLAIR') is a planning tool for situations where work is to be loaded onto resources with limited capacity. Special techniques are used in FLAIR to maximise plant utilisation and improve delivery performance. Finite capacity planning.

Aware Business Systems Pty Ltd	The Aware Enterprise System is an enterprise application covering manufacturing and distribution, for SMEs. Starting from scratch in Jan 2001, it was released in early 2002. Mini-ERP—SMEs.
Bowen & Groves Pty Ltd	Bowen & Groves is a privately owned ERP software development firm entirely dedicated to enterprise resource planning (ERP) software and providing customer support. 'M1' is designed for the small to medium manufacturer that requires total integration and automation from quoting through invoicing and is capable of flexible and fully supported customisation. ERP—SMEs.
Citect Pty Ltd	Citect is the largest independent supplier of industrial automation software in the world, and has provided engineering services and software to the industrial automation market for over 30 years. Citect develops (i) automation software, (ii) software for facility monitoring and (iii) a suite of business products linking plant systems to industrial information management systems. Industrial automation software.
De Data Pty Ltd	Sydney based software developer De Data provides the 'Purveyance' field-force automation system for distributors and manufacturers of fast moving consumer goods. (Clients include PZ Cussons, a major soap manufacturer and distributor). Field-force automation—FMCG manufacturer-distributors.
Giraffe Production Systems Pty Ltd	Giraffe Production Systems supplies software for manufacturing resource planning and production scheduling. Giraffe solutions are customised and closely oriented to the specific requirements of manufacturing customers, to realise the productivity benefits of Microsoft technology. MRP and production scheduling—SMEs.
Hansen Technologies Ltd	Hansen Technologies is an information technology solutions and services provider. Hansen offers billing solutions, asset and resource management solutions and IT services to its customers globally. Visy Paper is a client, although the manufacturing sector is not stated to be a target market. Asset management solution—asset-intensive manufacturers.
Infocomm Software Pty Ltd	Infocomm's dpManufacturing is a fully functional manufacturing system for small and large operators. It is designed for use by contract manufacturers and specialist manufacturing firms. MRP/ERP—contract and specialist manufacturers.
Infomedia Ltd	Infomedia Ltd has produced versions of its electronic parts catalogue products for most leading car manufacturers in Australia, and internationally for Daihatsu, Ford, Hyundai, Land Rover and Toyota. Products also include data interpreting solutions for the automotive and oil industries, and business solutions for the automotive dealer sector. Parts catalogues—automotive and similar.

InterDynamics Pty Ltd	InterDynamics Pty Ltd is a creator of integrated supply chain planning and operational management software tools, including simulation, visualisation and decision support. Various, especially process simulation modelling.
Ironbark Software Pty Ltd	Ironbark develops and supports flexible business management software for dynamic, high growth firms in specific industries, providing them with the information they require to run their business processes effectively and efficiently. Manufacturing is one of Ironbark's target industries, alongside timber, seafood, building & construction, fuel distribution and fresh produce. Mini-ERP—SMEs.
Itech Corporation Pty Ltd	Itech Corporation is an industrial automation and information integration company. Itech is active in the areas of; industrial automation products; PLC's, drives, AC servos, programming software, SCADA software, machine performance monitoring software, human machine interface touch screen workstations, and vision systems. Industrial automation products and software.
Mainpac Pty Ltd	Mainpac provides a sophisticated asset management solution which emphasises integration with ERP, SCADA, FAS, GIS and other information systems, and incorporating a risk management methodology which complements the functionality of the software. Asset Management Solution—asset-intensive manufacturers.
ManuSoft – trading name of Manufacturing Software (Aust) Pty Ltd	ManuSoft's dynamic resource control software covers the complete range of manufacturing activities from job quoting, through production control, stock and inventory control and onto product despatch. Implement either as independent functions or as a fully integrated manufacturing resource planning (MRP) system. MRP/production control—discrete manufacture.
Markinson Technologies Pty Ltd	Markinson Technologies' MomentumPro™ covers bill of materials, demand forecasting, DRP, financials, inventory management, materials requirements planning, production scheduling, purchasing, sales, warehousing and store management for manufacturing and distribution SMEs. SCM / inventory, store and warehouse management.
Mid-Comp International Pty Ltd	The firm's key products are (i) the Odyssey web based warehousing, distribution, accounting and logistics system, and (ii) the Snapshot/400 iSeries monitoring software. Mid-Comp International is the first Australian firm to join EPC Global, the international body charged with standardising the Electronic Products Codes (EPC) used in radio frequency ID (RFID) tags. Warehousing and distribution systems, inc. RFID.
Mincom Ltd	Headquartered in Australia, Mincom is a global technology partner for asset-intensive industries. Mincom delivers enterprise and e-business technology solutions to mining, utilities, transportation, defence, manufacturing and government industries. The flagship

	product, Mincom Ellipse, is a leading enterprise resource planning (ERP) software solution. Full ERP—asset-intensive manufacturers.
Objective Corporation Ltd	Provider of Enterprise Content Management (ECM) across five target markets mentioned, including Engineering & Infrastructure (e.g. Clyde Engineering is a client). Organisations in this sector may differ in their core business processes and functions but commonly have significant business risks attached to the fabrication, management or use of highly engineered products or environments. Enterprise content management—highly engineered products.
Perennial Software Pty Ltd	Perennial's enterprise management software, Perennial Enterprise Manager, helps small to mid-range manufacturers and wholesale distributors manage their supply chain. Supply chain management—SMEs.
PowerPlus Pty Ltd	PowerPlus is an Australian-owned software research and development company, which specialises in the areas of Knowledge Management (KM) and Business Process Management (BPM). These solutions enable organisations to expose and streamline business practices and manage corporate knowledge. Business Process Management—(no specific manufacturing focus).
Procex Pty Ltd	Procex provides scheduling and optimisation software, initially for the pulp and paper industry but also more generally to process industries, plus expertise in: advanced process control, manufacturing decision-support, scheduling & optimisation, expert systems, neural networks, control system design, control systems audits. Scheduling & optimisation software—pulp & paper and other process industries.
Pronto Software Pty Ltd	Pronto Software is an international provider of fully integrated enterprise management systems. PRONTO-Xi Manufacturing integrates the entire supply chain from sales to operations, distribution and finance, providing an accurate view of the critical elements in the manufacturing operation. ERP.
Qarm Pty Ltd	Founded in 1988, Queensland base QARM Pty Ltd is a worldwide leader in manufacturing software solutions that help manufactures realise their firm and machines tool's full potential. Qarm is the parent firm and development arm of OneCNC. Main products are CAD and a fully integrated CAD with CAM, plus modules specifically produced for mill, lathe, wire EDM, plasma, router, profiler, waterjet. Qarm also produces related file verification and communications software. CAD-CAM systems and manufacturing solutions.
QX Corporation Pty Ltd	Locata is a new, unique radio-location technology. Similar in concept to Global Positioning System (GPS), and for application in areas as large as cities, it offers improved reliability, accuracy and

	versatility. Applications exist in heavy industry, ports and airports, warehousing and elsewhere. BlueScope Steel has conducted trials. Various, e.g. automatic stores and warehousing operations.
Seeing Machines Pty Ltd	Seeing Machines is an award winning technology firm with a focus on vision based human machine interfaces. Formed in 2000, Seeing Machines' purpose is to commercialise its computer-vision IP across a range of industries and applications. Some of the core technology found in faceLAB™ originated in the Australian National University Systems Robotics laboratory. Designed with robot-human interaction in mind, faceLAB's™ facial acquisition and tracking capability can bridge critical gaps in communication. Automation and robotics.
Uniware Pty Ltd	Uniware offers solutions for accounting, distribution, manufacturing and service management. In relation to manufacturing, AusVantage is an integrated product (accounting, distribution, manufacturing), plus warehouse control, ordering and service management, with complete SCM and CRM facilities. Mini-ERP— SMEs.
Welding Technology Innovations Pty Ltd	WeldPrint is an online fault detection system for welding. Analysing weld quality continuously in real time, and signalling a welding problem instantly, it is suitable for all fully automated arc welding. Fault-detection unit and software—automatic-welding machines.

Source: CIER Analysis.

Innovation base and support infrastructure

There has been a considerable focus on manufacturing research in the public sector in Australia for many years, but, as is the case in other vertical markets, there seem to be few direct linkages between Australian manufacturing software development firms and this research base, with most research linkages identified being primarily directly to the user companies.

It is also significant that most manufacturing research in Australia is concerned with areas that, whilst they may use software as a tool, do not necessarily result in new or improved software products as an outcome.

For example, the CSIRO divisional group for manufacturing and infrastructure technology lists its core capabilities as:

- **thermal and fire science**—scientific aspects of combustion processes and their control, and modelling the physical and social effects of bush and urban fires;
- **fluid dynamics**—understanding the flow and mixing of fluids, and its application to health and security needs;
- **metallurgy**—development of new alloys and processing methods, concentrating on light metals;
- **urban systems integration**—sustainability science for built environment applications;
- **decision systems**—infomatics systems for complex multifactor decision-making;
- **optics and diffraction**—visible light and X-ray advanced optical theories, applications and instrumentation;

- **ionic and electronic materials**—theory and applications of ionic solids and liquids, and of electronic materials;
- **soft matter**—design of materials that are easily deformable by external stresses, typically possessing structures which are much larger than atomic or molecular scales; mesoscopy;
- **interfacial science**—design and control of the interfaces between materials, and applications to mechanical, chemical and biological processes at surfaces; and
- **sensing and interpretation**—design and fabrication of sensors, and processing and interpretation of signals.

While each of these core capabilities may have some peripheral software development associated with them, only ‘decision systems’ has a direct ‘informatics’ (possibly software), outcome.

The situation is similar in other institutions. Australia has a vibrant robotics community with a substantial number of internationally strong research groups (including National ICT Australia, ARC Centre of Excellence in Autonomous Systems, the ARC Centre for Integrated Dynamics and Control, the ARC Centre for Perceptive Intelligent Machines, CSIRO Robotics, and Universities of Melbourne, Queensland, Wollongong and Western Australia) and these different groups bring a diverse range of skills and research excellence to bear on the problems faced in developing autonomous robots.

The Cooperative Research Centre for Intelligent Manufacturing Systems and Technologies (CRC-IMST) was established by five universities, 13 manufacturing companies and the CSIRO. Its mission is to be a world-class centre for the development and application of intelligent manufacturing systems and supporting technologies, with research programs focusing on the following.

- Future generation machines and equipment—to improve the performance of production machines and equipment by integrating autonomous decision-making ability, new control strategies and actuator and sensor systems, which automatically adapt to changing environments and varying process requirements
- Real time sensing and machine control—to develop leading edge sensor systems and technology for sensor fusion, for application with new and emerging sensors in manufacturing situations
- Sustainable and environmentally friendly manufacturing—to develop strategies and technologies for design, manufacturing, usage and disposal of industrial products that are environmentally sustainable
- Information systems in manufacturing—to investigate how design and manufacturing information generated from existing isolated application specific manufacturing systems can be captured and transformed into knowledge which can be implemented as manageable entities shared by globally distributed project teams and used beyond manufacturing to end of the product’s life
- Advanced processing of materials—to investigate and develop new high-speed machining technologies, laser beam and water jet processing technologies and

software simulation packages for the next generation of production machines and materials¹⁶⁷

CRC-IMIST corporate partners include ANCA, Hawker de Havilland, Sola International, Technical Components (now Tytronics), Mitsubishi Motors, Schefenacker, Philmac, Dynek, and Godfrey Office Equipment.

The CRC for Welded Structures has developed *INservice* welding software in joint research with the Australian Pipeline Industry Association to aid the management of in-service welding procedures on gas pipelines.¹⁶⁸ CRC-CWS's corporate partners include Agility Team Build Pty Ltd, Australian Pipeline Industry Association Incorporated, BlueScope Steel Limited, CIGWELD, Connell Wagner, OneSteel Limited, and Woodside Australian Energy.

Similarly, the CRC for Integrated Engineering Asset Management develops models and decision systems, sensors and diagnostics relating to asset management applications in such areas as process manufacturing and utilities and the CRC for Construction Innovation has developed ICT platforms with application to industries in the building and construction value chain.

Such examples demonstrate that whilst the manufacturing software-related research base has significant capacity and capability, and could be a support, in terms of capabilities and software development to the Australian software industry, it does not appear to have many direct linkages with independent Australian software developers.

It is probable that some indirect linkages with Australian software developers exist, via the user companies identified above. However, some members of the research community also have the potential to be direct market competitors to specialist software developers when they work directly with the end-user clients.

Opportunities

Opportunities in the manufacturing software vertical market

Our analysis, based on the material presented above, suggests that the primary categories of opportunity attractive to providers of software for sub-verticals in the manufacturing sector include:

- ERP modules addressing the specific needs of manufacturing sub- or micro-verticals;
- specialist applications pertinent to the specific needs of niche users in the manufacturing sub- and micro-verticals; and
- systems integration and systems implementation services relating to ERPs within manufacturing sub-verticals.

In each of these categories, international opportunities exist for Australian developers who have credibility in the industry (both in terms of having sector-specific knowledge/expertise and being an established business entity), have strong and ongoing innovation capabilities, and who are in a position to access distribution channels in the relevant

geographic regions. Providers may need to form alliances in order to present a vendor organisation of suitable ‘weight’.

An example of an Australian organisation that already has such ‘weight’ is Mincom.

Box 17. Mincom profile

Mincom funded all its early export efforts itself, from operating cash flow. The company was fortunate in that its primary market sector, mining, already had a number of global players when Mincom was started in the 1980s. As a result, Mincom’s early Australian successes created a degree of brand recognition in other countries with a strong mining sector – particularly South Africa and North America. Mincom was able to use this to get a hearing from prospective customers, and then was successful in securing that all-important foundation client in the new geography. In the first eight years of Mincom’s existence it self-funded establishing export markets in North America (Canada and USA), South Africa and Indonesia.

The fundamental concepts behind the Mincom software products and associated service packages were based upon the experiences of the founders and those that joined the company in its infancy. Early support for Mincom products was derived from customers who recognised the potential of the software for their business and provided ongoing feedback to ensure the software being developed would meet their needs. This reflects the size of the gap in the marketplace that Mincom software was filling and validation of Mincom’s approach to customers.

In one case an early adopter of Mincom software helped fund its further development by pre-paying a proportion of the licence fees. Apart from this all R&D was funded from cash-flow. R&D has always been a core priority for Mincom and a significant portion of earnings are ploughed back into R&D. In fact R&D spending increased 23 per cent during 2003-04 to capitalise on opportunities in mining, defence and utilities.

Mincom has collaborated with numerous technology partners to enhance solutions. For example, a recent agreement with Dexterra provides mobile connectivity to the Mincom Ellipse product and Mincom also has a long and fruitful technical alliance with IBM. Mincom is branching into new areas of technology such as specialised business to business ecommerce solutions and exploring alternative ways to fund accelerated development to capitalise on burgeoning market need.

Critical success factors for Mincom’s development and sustainability have been:

- specialisation in five key industries through identifying and addressing deficiencies in the current software solutions available;
- development of transportable software that can be used on a wide variety of platform combinations, i.e. hardware, operating software and databases enabling solutions to be offered to companies with an existing standard platform;
- diversification into utilities support as their products meet the software requirements of remote mining communities in Australia which operate infrastructure and services such as railways, power generation, ports, roads and housing;
- responding to the ‘outsourcing’ by the mining sector who was also an early adopter of ‘outsourcing’, by providing services such as facilities management. These multiple sources of revenue have proven invaluable from a sustainability perspective; and
- selecting core alliance partners, significant because of geography, industry or market and developing longstanding, supportive relationships with key clients.

Source: Prime Minister’s Science Engineering and Innovation Council (2005) Growing Technology-Based SMEs, Final Report March 2005, Canberra.

There are opportunities for software companies providing ERP modules which extend the scope, or tailor the functionality, of more basic or general ERP packages to address the specific needs of manufacturing sub-verticals.

Particular areas of interest include manufacturing execution and supply chain execution, in combination with RFID solutions targeting specific sub-verticals. When tailored for specific manufacturing segments, there are also attractive opportunities providing such applications as business process management¹⁶⁹ and document/content management systems, which tend not to be present in more than elementary form in an ERP.

In 2004, global ERP revenues totalled US\$24 billion, according to AMR Research. In terms of the size of this opportunity, ERP software licence revenue is forecast to grow at a compound annual rate of 6% through 2008, reaching 6.3% by 2009. North America will lead with 6.3% compound annual growth. In the Asia-Pacific region, ERP sales grew 5% in 2003, and they are forecast to grow steadily to reach \$531 million in 2008.¹⁷⁰ A short term 'blip' in these growth patterns may be caused by the advent of web services, discussed earlier. However, the overall trend is business driven and, as discussed previously, technology is unlikely to be a significant driver in the medium term.

The fact that ERPs originated in the manufacturing sector gives a *prima facie* reason for the sector to be well penetrated. However a strongly penetrated market may still have significant opportunities¹⁷¹ and thus the degree to which markets have been penetrated can give a misleading impression.¹⁷² For example, many, perhaps most, ERP implementations are only partial, focusing first on financial management or HR modules. Moreover, many ERP investments were made some time ago, particularly in response to Y2K concerns, and they may be due for revisiting. Given the size of the sector worldwide, even a slice which is small in percentage terms can be of considerable size.

In some markets, where low cost of labour previously deferred the business case for ERPs, there is now an increase in take-up. In India for example, nearly half of users are reported to have deployed custom-built applications, whether developed in-house or by external providers.¹⁷³

The opportunity to sell ERPs into the manufacturing sub-verticals is available to two supplier groups:

- existing ERP providers (by adding sector-focus to their offerings); and
- application module providers (by extending the scope of their applications software (either alone or working with others) to offer 'best-of-breed' combinations).

For ERP providers, adding sector-focus requires a great deal more than simply building relevant functionality into the product. It requires:

- extensive knowledge in an industry that has unique end-user needs (unique end-user needs lead the demand for vertical applications and make entry by horizontal applications vendors more difficult);

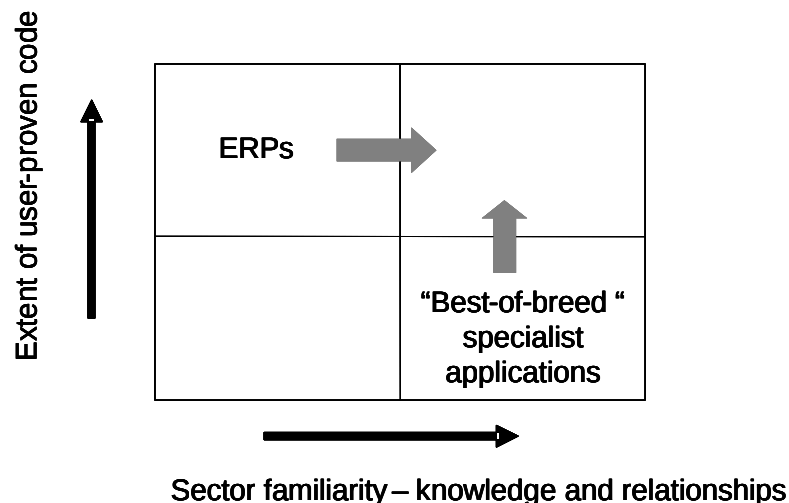
- focused R&D to achieve product differentiation that allows them to compete with horizontal applications vendors; and
- focus on international markets and, in many cases, access to global distribution networks in those markets, established through partnerships and alliances.¹⁷⁴

Such attributes and capabilities are the hall-marks of successful application module providers.

It will not be easy for either of the above supplier groups to succeed alone, particularly for application module providers. However, specialist providers may be helped by the growing influence of operational executives (rather than CIOs) in decisions regarding investment in ERPs. Application module suppliers will also need to convince prospective customers that the software will continue to be supported—and enhanced—throughout the lifetime of the investment.

However, providing specialist niche application software to a worldwide audience can be done. ‘Best-of-breed’ applications can succeed. The French MAK-SYSTEM Groupe International (www.mak-system.com) has developed a successful business (650 installations in 26 countries) by exploiting a niche in the blood products market with a product that tracks all relevant aspects of each unit of blood being managed by the client. The functionality is standard ERP, but where the product lacks financial functionality, connections with Oracle Financials fill the gaps.

Figure 14. Competing routes to sub-vertical markets



Source: CIIER Analysis.

ERP providers are under great pressure due to (relatively) saturated markets and to increased demand from prospective customers for solutions which closely match their specific business needs and deliver clear value-for-money.^{175, 176} Consequently, many of the larger ERP providers are moving into new verticals.

For example SAP introduced *mySAP Insurance*, and the company is moving into the financial services, retail and the public services markets. They are also expanding their capabilities by broadening their offering in terms of functionality (e.g. UGS, the product lifecycle management company, which acquired Tecnomatix in 2005, a leading provider of process management software for the manufacturing sector).

The attractiveness of partnerships between providers of applications modules and ERP solutions will be increased by a strong take-up of web based services.¹⁷⁷ A decisive industry move to web based services could even challenge an important *raison-d'être* of ERPs. Introduction of the 'Dynamic IT' environment, which many CIOs now espouse, would facilitate this route.¹⁷⁸

In general, while many of Australia's application module providers have strong credibility, networks and relationships within their respective sub-verticals within Australia, they may lack this support in overseas markets. This means that there is a risk that as Australian ERP module providers link up with global providers, they will become a target for takeover and may then be lost to the Australian software sector, potentially reducing competition and thus choice for Australian manufacturers.

In supplying ERP modules, a variety of routes to market are possible. An important criterion in choosing the preferred route relates to how the relevant IP is not only retained but continually enhanced. The balance of power between ERP provider and Application Module provider will be crucial. Where the latter can secure the position of 'Channel Partner', bringing sector credibility and expertise, it will be in a much stronger position than if it does little more than provide the code relating to a limited area of functionality. Selection of channel partner(s) has a potentially huge influence on success in the marketplace.

Specialist applications

Specialist applications for ICT comprise a wide variety of categories of software, including process automation and product lifecycle applications. The opportunities for specialist applications are many and varied. Each relates to the specific needs of niche users in the manufacturing sub- and micro-verticals, and to associated support services. Some of the applications include: Machine Vision, Manufacturing and Control Systems, including SCADA/MMI/HMI, Expert Systems / Decision Support / Artificial Intelligence; Design software, including CAD 'add-ins', Systems simulation and other niche software, especially where linked to domain expertise.¹⁷⁹

The size and scope of the market for these applications is difficult to estimate realistically, as they represent a latent need rather than an existing market, but they also represent emerging opportunities for new and innovative software.

The public sector research foci identified earlier in this chapter include a number of similar application areas to those within this market. Some of this new software product

could, theoretically, emerge from these research outcomes through spin-outs or appropriate Australian software developers and distributors.

Specialist applications are, however, frequently unsuitable as commercial products. They are often developed in-house by manufacturing firms to address very specific objectives and the programming environments are often not 'industrial grade'. The cost of re-writing the application to address a more generic objective and to make it compliant with appropriate programming standards is usually enough to limit the prospects of commercialisation.

The software companies developing such software for 'in-house' use, even where they have retained IP rights, may also have insufficient business resources for commercialisation and for successful international marketing.

Australian businesses that can find target buyers for their specialist application niche products may therefore succeed domestically but it may be more difficult for them to grow internationally.

Box 18. Specialist applications—manufacturing and control systems

Manufacturing and Control systems includes: distributed control systems (DCS), programmable logic controllers (PLC), supervisory control and data acquisition (SCADA) systems, networked electronic sensing systems, and monitoring, diagnostic, and assessment systems, and encompassing all human/machine interfaces, for continuous, batch, discrete, and combined processes. Applications exist in the utilities sector as well as manufacturing sectors such as the plastics and chemicals, pulp and paper, automotive, fibres and textiles, and food processing sectors.

Asia is the world's key growth region, with China and India acting as the twin engines of economic growth. Large capital investments are being made in almost all vertical industry segments, including chemical, electric power, metals & mining, and oil & gas. With the manufacturing industry thriving and with manufacturers extensively applying control systems to gain sustainable competitive advantages, the Distributed Control Systems (DCS) market is flourishing in Asia.

Source: ARC Advisory Group, www.arcweb.com/research/auto/dcs-asia.asp

Systems integration and systems implementation services

Whilst not strictly the supply of software products, systems integration and systems implementation services relating to ERPs within manufacturing sub-verticals also present considerable opportunities. When a client buys an ERP, a considerable amount of configuration and customisation work is required. Similarly, when the solution involves more than one vendor, there is also a considerable amount of integration work required to connect the different applications.

The size of the market is, however, difficult to estimate, as it depends on the activity of a number of suppliers across the global marketplace, and on client orientation to such services. There may also be an opportunity for Systems Integration providers to leverage a solution developed for a particular client, by re-using it for other clients in the same industry sub-sector (e.g. scientific instruments manufacturers). In practice, this does not appear to have happened to any great extent.

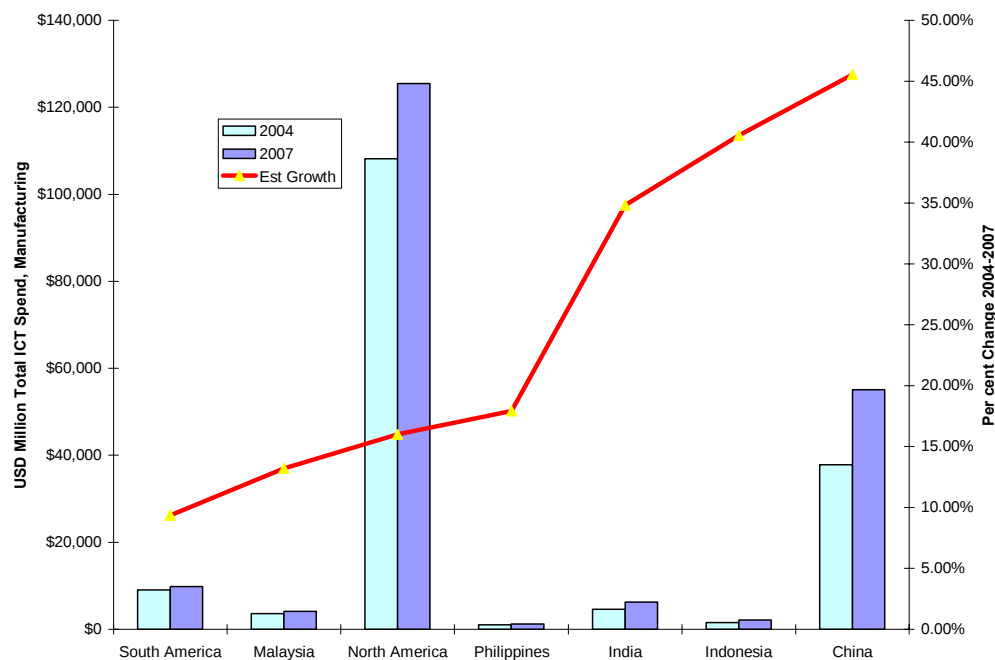
A number of Australian firms have significant and relevant experience and expertise. Two examples are Capability Management (www.capability.com.au) and TallShips (www.tallships.com.au). Provision of these services in overseas markets would enable Australian firms to cultivate relationships there while continuing to extend their industry-specific knowledge regarding required software functionality.

Opportunities by geographical region

The global ICT manufacturing market was quantified earlier in this chapter. In general terms, given the increasing global integration of manufacturing, bringing more uniform user-requirements for a given sub-vertical and bringing the benefits of scale, the market for enterprise applications software addressing the sector has increasing uniformity. This is also true for specialist applications. A small increase in benefits achievable from the use of a particular software application translates to large global gains. North America and Western Europe are markets with strong and established domestic suppliers for enterprise applications, and therefore will be more challenging to enter.

Most of the statistics for this section are derived from Austrade's website (www.austrade.gov.au).¹⁸⁰

Figure 15. Total ICT spending—manufacturing (selected countries)



Source: WITSA Digital Planet 2004, analysed by CIIER. Data for the chart is provided in Annex 3, Part C.

North America: Most Fortune 500 firms have implemented a range of enterprise applications. This market is traditionally difficult to enter for overseas providers, because of the strength of local suppliers. However, for offerings with a clear market advantage, the potential is huge.¹⁸¹ As the leading adopter of this technology, there may be opportunities to sell replacements for existing (now legacy) systems, especially where specialist software has now been developed.

South America: Manufacturing averages 20-30% of GDP in South America, with significant activity in petrochemicals, machinery and equipment, food processing, iron and steel, textiles, paper and pulp, automotive and commercial aircraft. Niche products in these sectors may be attractive in this market, while simpler and lower cost applications which only address manufacturing may also appeal.

India: India's manufacturing sector spent an estimated USD 180 million (AUD 237 million) on software in 2002. India has demand for manufacturing-specific applications (ERP, SCM, CRM, etc.) especially at the SME level. Standalone modules are well regarded. The ERP market for manufacturing sector is relatively saturated (based on an

average penetration level in 2003 of 37%, with notably higher figures for larger enterprises and for the manufacturing sector). However, many implementations focused on financial management.

China: China's domestic providers are only able to meet 30% of demand. The nature of Chinese economic growth, with its concentration on massive, low cost industrial production for local and overseas consumption, means that control and resource management must be well organised. Generally, there are opportunities in China for SCM, ERP, CRM and SCADA, and increasingly for PLM.

As an example, Zhejiang province, one of the country's leaders in ICT, has opportunities for software tailored to specific industries, production control software, and engineering software.¹⁸²

Indonesia and Malaysia each have unsatisfied demand in relation to systems integration, CRM and e-manufacturing/B2B. Given Indonesia's acute shortage of ICT skills, it is likely that the ASP (or 'Software as a Service') model will prove attractive there. The Malaysian government is keen for ICT projects to generate inwards knowledge transfer. The **Philippines**, with a rich ICT skills pool, has needs for CRM and Supply Chain Execution software.

Worldwide, various reports suggest that SMEs are demanding shorter implementation times, to achieve faster return on investment, so some solutions are being sold on the basis of 60-90 day implementation. There is a substantial market for upgrading CAD systems from 2D to 3D, and this is being vigorously pursued by the major CAD vendors.

There are also overseas opportunities for implementation specialists and systems integrators. An example of this is a proprietary methodology for enterprise systems implementation (Capability Management), which focuses on identifying and measuring business value. By defining and aligning processes so that they support business goals, target business and financial goals can be identified. The systems implementation is then project-managed to realise these objectives.

The size of an untapped market and the ability to supply and support it is not the only measure of market attractiveness. Others include market accessibility (which may be impacted by regulations, local buyer behaviours and preferences, and other factors), and the goodness of fit with Australia's strategic and sustainable competitive advantages. Australia's proximity, in geographical terms and in terms of time-zone, is an important strategic competitive advantage. This advantage, in contrast to Australia's 'competitive labour costs relative to other developed countries',¹⁸³ is immutable. It is an advantage on which the Australia software development sector would do well to focus, as it gives rise to an inherent capacity to be a preferred support base for the Asian region

Manufacturing market conclusions

Our assessment and analysis set out above leads us to the following main conclusions about the opportunities for Australian participation in software development for the manufacturing sector globally.

There is an opportunity for Australian software developers to sell specialist modules for manufacturing under the umbrella of the global ERP vendors as channel partners. There is also an opportunity to focus on the integration aspects of manufacturing needs in order to extend the current base-level ERP applications in many parts of the world by connecting specialist modules developed for niche markets in Australia.

Channel partnering strategies (pursuing specific sub-verticals in conjunction with generalist providers) will let smaller developers ride on the back of the ERP majors. There is also an opportunity for Australian developers to focus on ASPs and web services in support of major ERP platform solutions. Such modular gap-filling is most likely to be successful where the developers are credible with both clients and ERP vendors.

While strategic cooperation with the ERP majors is considered to be one of the best opportunities to on-sell locally developed solutions, Australian operations will need to keep in mind the risks inherent in such partnerships. Small Australian developers may need help to develop their channel partner strategies, and prepare themselves for genuine partnering. Australian developers need to focus on the manufacturing sector and more specifically on sub-sectors to understand their particular needs and provide products that do not require extensive configuration or rewriting.

There may also be an opportunity to take developments out of the research environment and build commercial products, though it will be difficult to pick commercial winners. Australian vendors are not locked out of any geographic area, but one size will not fit all markets. Niche specialisation will be the strategy most likely to succeed in mature markets. On the other hand, developing markets offer opportunities to sell non-finance modules and SME specific products. Australia is well positioned to offer integration services to the Asian region with a combination of country presence and support from base without the difficulties of long distances or time zone shift.

Minerals

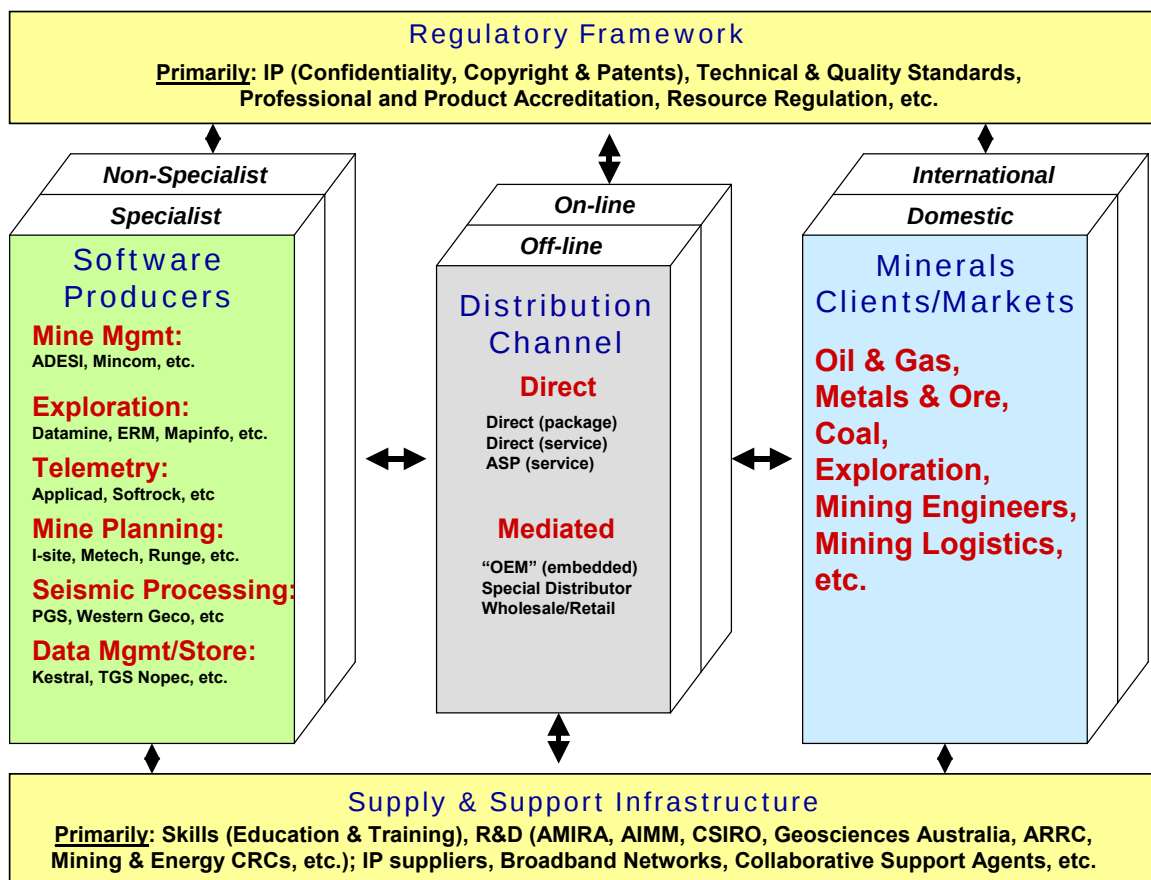
For the purpose of analysis, the minerals vertical market is divided into mining (i.e. metals ore extraction, coal and other related industries, including those providing mining engineering and mining logistics), and oil and gas.

The minerals software product system

Minerals vertical market software producers provide products and services to areas of activity including management and administration; exploration, geological survey and mapping; telemetry; and mine and facility planning.

Australia is known for its success in mining software, with a number of established developers. This success has been due, in part, to Australia's strength in the mining industry, with leading international players in the industry and a strong support industry (e.g. mining engineering, logistics, exploration, etc.). Strong linkages between clients and developers are an important feature of the mining/minerals product system.

Figure 16. The minerals software product system



Source: CSES Analysis.

Producer-client linkages are crucial for innovation and development. There are also opportunities to further develop innovation system linkages with the underlying research and support infrastructure, where it is focusing on mining and related issues. Some of these are identified and analysed further in the Innovation Base section later in this chapter. The close linkages between these three related groups (i.e. software developers, their mining industry clients and those providing related innovation support services) provide a foundation for the development of high level skills among minerals vertical market software developers.

Two notable features of the minerals software product system are the lack of distribution channel mediation compared to other vertical markets and comparatively lower levels of non-specialist and in-house software development, in mining, but higher levels in oil and gas. The lack of distributors acting as ‘middle-men’ contributes to the realisation of the synergies noted above, while the sectoral difference in internal support suggests further opportunities for market expansion.

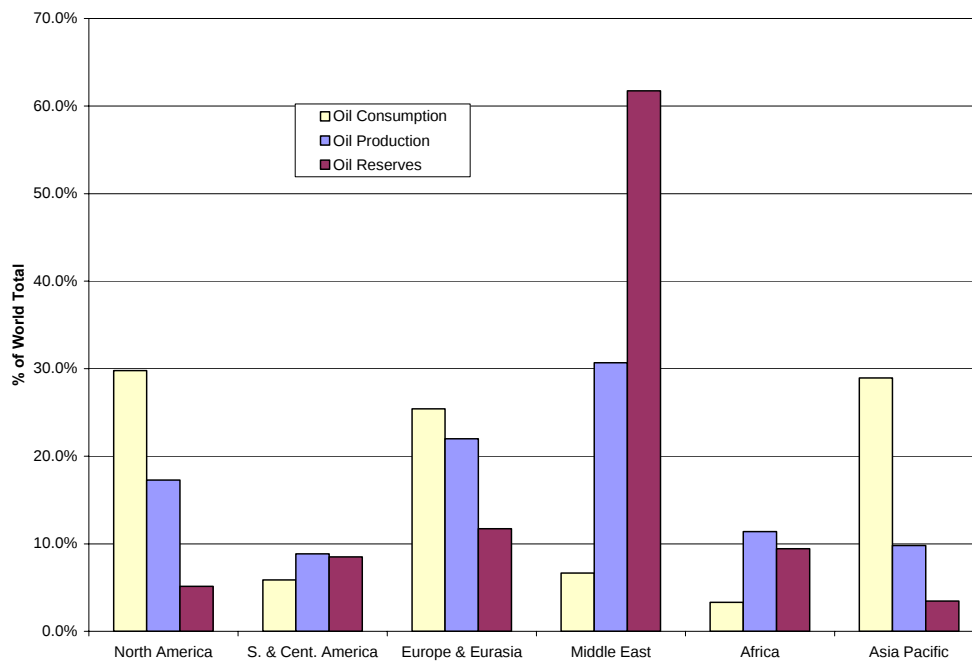
Minerals markets

The US, Canada, Australia, South Africa and Chile dominate the global mining scene for minerals, and have become the traditional leaders in mining and exploration methods and technology.

The Australian mining industry represents 4.7% of Australian GDP in 2001–02.¹⁸⁴ Gold, base metals, diamonds and platinum group elements (PGEs) are the more important commodities currently being explored for and developed globally. Australia is at the forefront of many advances in minerals mining and mining technology.

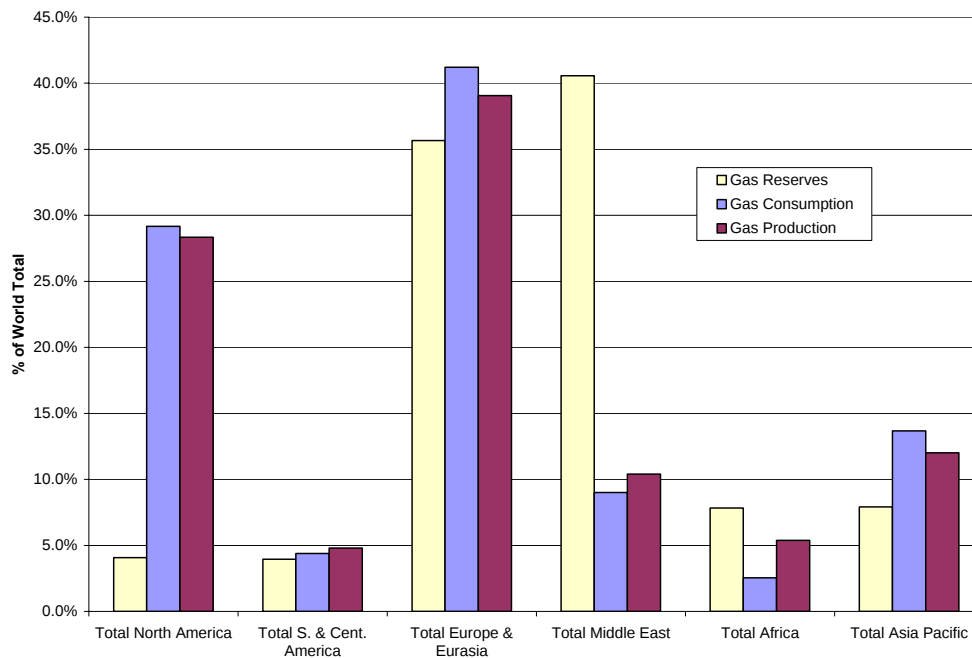
According to minerals industry consultant Colin Campbell,¹⁸⁵ historically North America, the Far East and Oceania, and Western Europe consume over 75% of the world’s oil, produce less than half and contain around 12.5% of the world’s oil reserves. The Middle East, in contrast, contains 65% of the world’s oil reserves, produces around 30% of world supply and consumes around 6% of the world’s consumption.

Figure 17. Global consumption and production of oil, 2003–04



Source: BP Statistical Review of World Energy 2005

Figure 18. Global consumption and production of gas, 2003–4



Source: BP Statistical Review of World Energy 2005

Consultants MBendi¹⁸⁶ also consider that many countries are using gas primarily for domestic consumption, and suggest that this may be in order to decrease the amount of oil imported or to increase the amount of oil that can be exported. Growing utilisation of gas for energy has improved infrastructure, and gas is becoming a primary focus for exploration in many areas. The charts above indicate that, on a regional basis, production is approximately sufficient to meet domestic demand in most regions, except for Africa and the Middle East. The reserves of the latter are globally significant but the Middle East is a comparatively small producer of gas.

The minerals software market

There is an often repeated claim that Australia supplies 60 per cent of the world's mining industry software.¹⁸⁷ This level of market dominance could lead to a presumption that the potential for Australia to gain significant additional export revenue is slight. However, this does not take into account the potential, but difficult to estimate, software market that exists in the many mines around the world that are either not using software at all, or using internally developed software as an alternative to commercially available software products. The very nature of the minerals industry also means that exploration continues for new mineral deposits, mining operations become viable or cease being viable depending upon mineral commodity prices, and new methods and processes of exploration and extraction continue to be discovered and implemented. So, the opportunities for sales of mining software continue to grow.

Oil and gas software, other than in the exploration area, appears to be mainly provided internally by the major oil firms themselves. This orientation to internal supply may indicate an opportunity for software providers to achieve more significant growth in this sector, but it also suggests that there may be a potentially important barrier.

Market drivers

While an increase in the dollar value of commodities drives the development of new mines and reinstates the viability of mothballed facilities, the relative scarcity of the commodity drives exploration and the development of new minerals facilities and may also increase prices and thus economic viability of previously uneconomic locations.

Both of these factors drive a demand for minerals software products and services to service new mines, to service new mining firms, and/or to improve processes at existing mining operations. While these 'market' drivers are the strongest influence on market growth, environmental, regulatory, safety and other work-place considerations are also driving demand for administrative and operational support software.

In the following analysis we have used exploration spending and production as indicators of the general level of spending on mining software and exploration also as a leading indicator for future software spending.

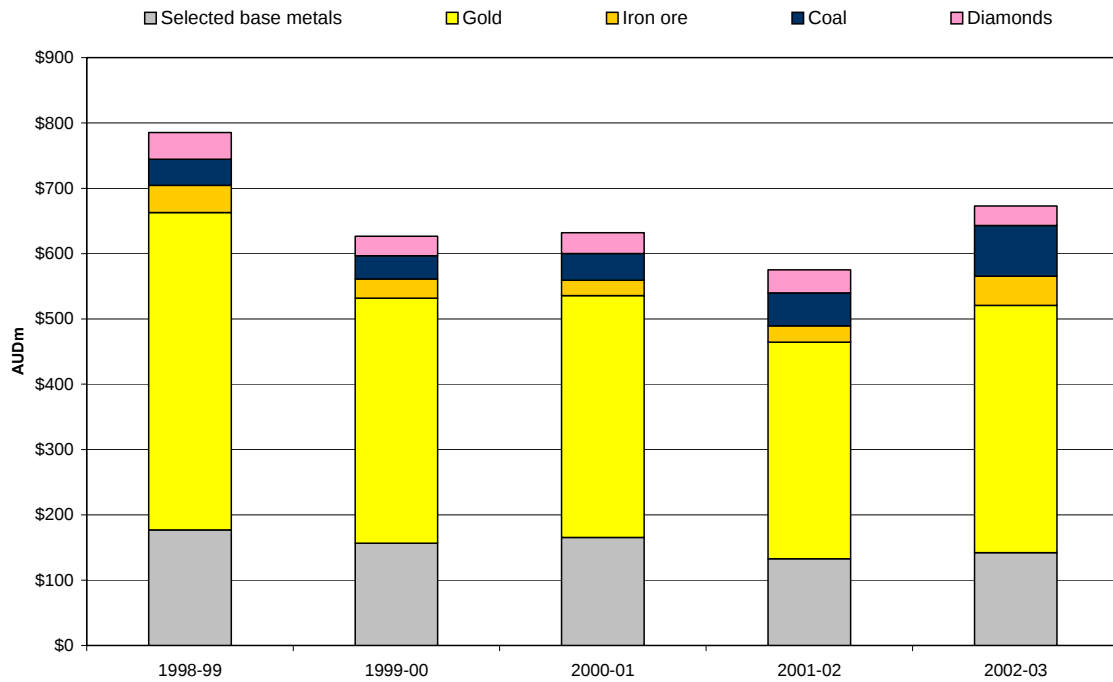
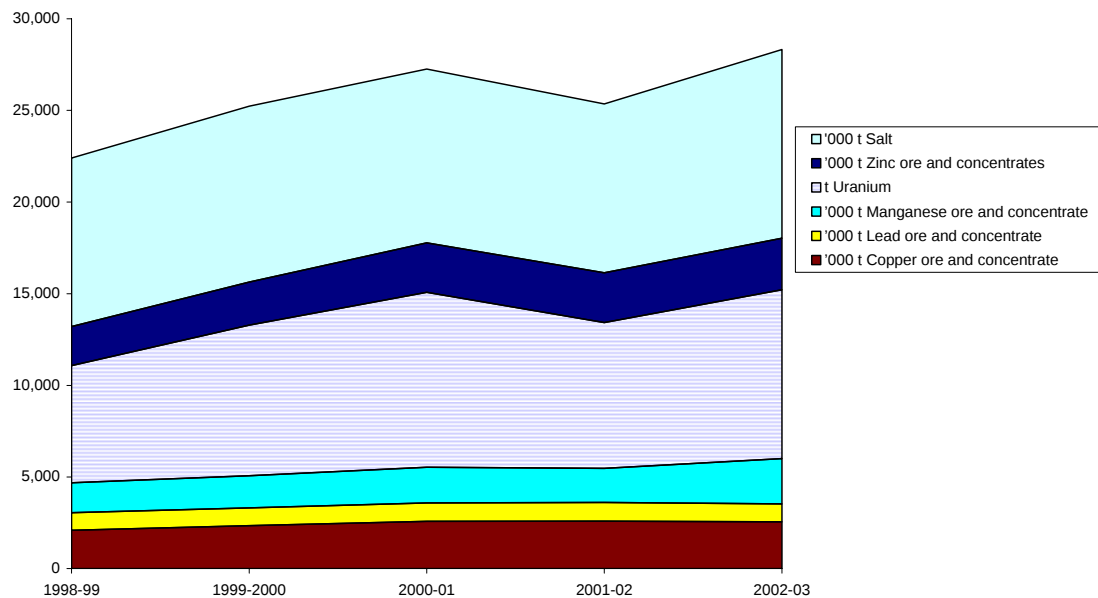


Figure 19. Exploration spending in Australia: minerals

Source: ABS 8412.0.

Figure 20. Minerals production trends, 1998–99 to 2002–03



Source: ABS 8412.0.

Exploration for gold, iron ore and coal have all increased slightly since 1999, despite a decline in 2001–02, thereby increasing Australian demand for software to service both the exploration process and potentially new mines.

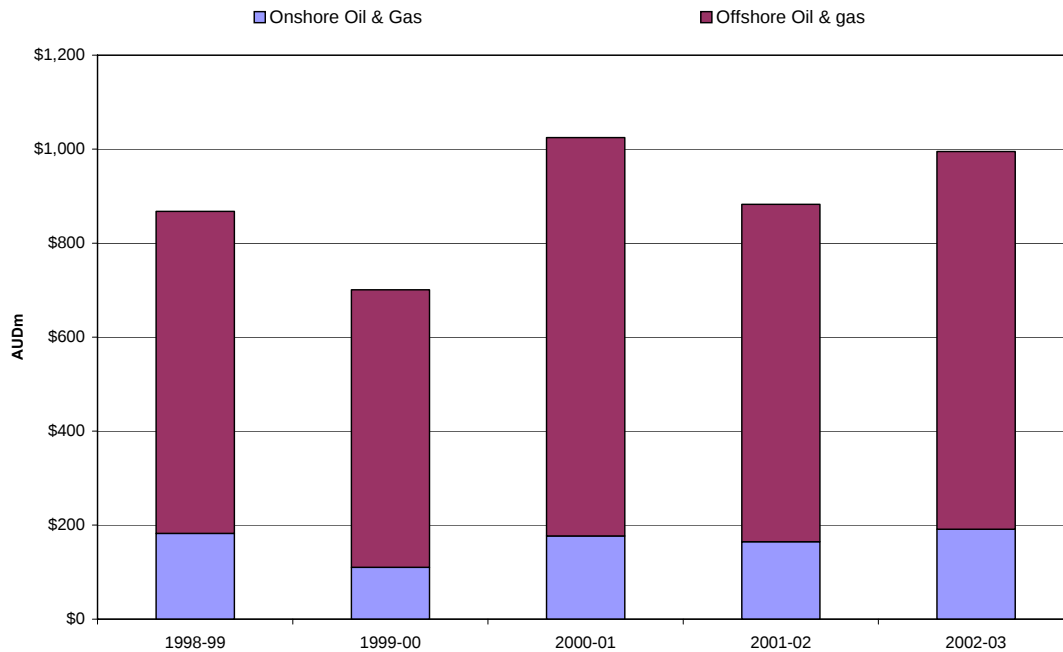


Figure 21. Exploration spending in Australia: oil and gas

Source: ABS 8412.0.

ABS indicates that growth in exploration for oil and gas has also occurred, and this is shown in the chart above. The current comparatively high price for crude oil, which seems likely to be maintained for some time, due to production issues in the Middle East, refinery problems in the Gulf of Mexico, and rising energy demand in China is expected by many commentators to continue that trend.

A recent article in the *Financial Review*¹⁸⁸ entitled ‘China boom fuels surge in IT spending’ quotes Douglas Snedden, a partner at consultancy Accenture, as saying that IT systems overhauls were part of a broader trend towards business re-engineering across corporate Australia.

Previously people might have re-engineered within their own four walls. Now in retail, manufacturing and mining, re-engineering extends to all the participants in a transaction.... In resources, we are talking about the coal chain as miners, operators and transporters look to improve connections between their businesses, just as retailers have embarked on supply-chain programs.

The same article quotes SAP global account director Kal Marshal:

There is a high degree of confidence in the sector around not only this boom but the next one, there's a significant demand from China right now, but these businesses are also anticipating that the boom from India, which is probably 12 or 18 months behind the China boom, will be as big ... So their confidence in investing in capital projects right now is based not only on the demand from China but the emerging demand from India as well. There is a lot of depth in this thing.

While both exploration and production trends rise and fall for particular commodities from time to time, the Australian market, when seen in aggregate, provides relatively stable market platforms, with the potential for long-term growth that can fuel vertical market demand for software.

Export Markets Software products and related services form a very significant proportion of mining technology services. The Australian Bureau of Agricultural and Resource Economics (ABARE) identified several export markets for mining technology services, including Eastern and South East Asia, and Central and South America.¹⁸⁹ In another report,¹⁹⁰ ABARE predicted export revenue from the provision of mining technology services in 2005–06 of approximately \$1.9 billion.

ABARE estimated \$267 million of this \$1.9 billion would be earned from exports of software products and related services. As an example of the levels of penetration of Australian software and services, Australian mining software is claimed to be used by over two thirds of the mines in Peru in South America, and this is expected to expand in the future.¹⁹¹

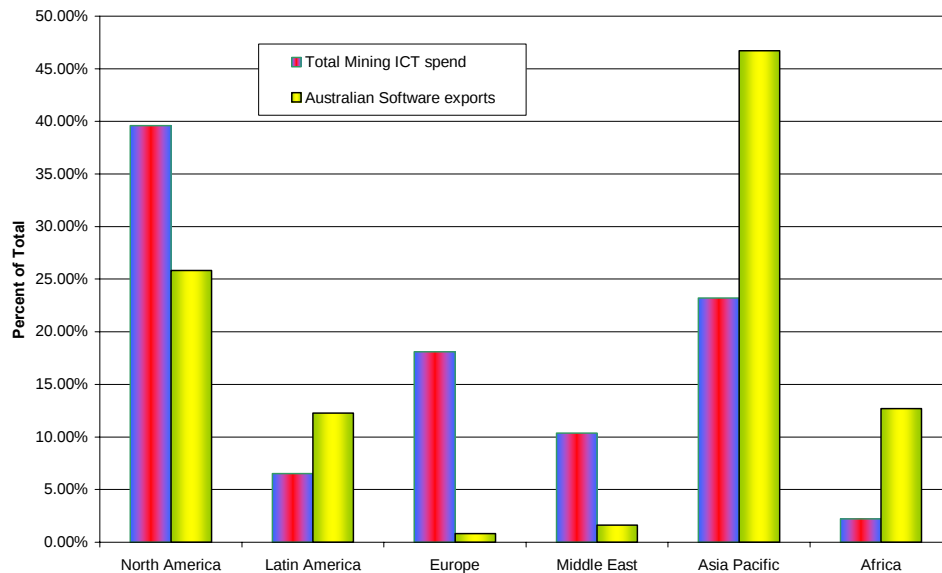
Export services identified as growth opportunities included: deployment of systems integration technologies, web enablement of applications, and enrichment and quality improvement of graphical interfaces through 3D and other capabilities delivered over broadband communications systems.¹⁹²

The graphic below shows Mbendi's¹⁹³ interpretation of the major mining regions of the world and thus the potential export targets for mining software.

Figure 22. Major mining regions

<u>North America:</u> North America is the major producer of gold and silver. Raw mineral production in 1998 was valued at approximately US\$ 70 billion. The industry employs approximately 1 million people. Major companies include Barrick, Newmont and Industrias Penoles	<u>Europe:</u> Europe is not a major mining center. However, it has several established base metal mines in Scandanavia, Ireland and the Iberian Peninsula. Major companies include Boliden and Outokumpu.	<u>Asia:</u> Asia is a major producer of base metals, PGE's, ferrous metals and coal. Most major producers are state controlled, but foreign investment is being encouraged, in particular by China, India and the CIS.
<u>South America:</u> South America is a major producer of base and ferrous metals, in particular copper and iron ore. Major companies include Codelco, Barrick, CVRD, Newmont and Rio Tinto.	<u>Africa:</u> Africa is a major producer of cobalt, gold, PGE's and diamonds. Mining accounts for a substantial proportion of several countries GDP's. Major companies include Anglo American, De Beers and BHP Billiton.	<u>Australasia:</u> Australasia is a leading producer of iron ore, gold and base metals. Major companies include BHP Billiton, Rio Tinto and Normandy Mining.

Source: Mbendi Information Services

Figure 23. ICT spend and Australian software exports by region

Source: ABARE and WITSA as above, analysed by CIIER.

When the current Australian software exports, shown above, are compared to MBendi's analysis of major mining locations and to the ICT spend patterns above, the key countries less penetrated by Australian mining software producers are clearly in Eastern Europe, the Middle East, and in countries not currently spending significantly on ICT in the Asia-Pacific region (e.g. China and India). The current discussions concerning a potential free trade agreement (FTA) between Australia and China may be relevant to opening up at least one of these markets.

Software firm Mincom is making a strategic foray into the booming Chinese resources sector and is reported to have signed a cooperative business agreement with a Chinese software and solutions provider, Shenyang Neusoft, which is understood to have 3000 large customers in China in electricity, telecommunications and utilities. Mincom has also secured business in Mongolia and Uzbekistan, and opened an office in St Petersburg in April 2005 to target the Russian mining sector.¹⁹⁴

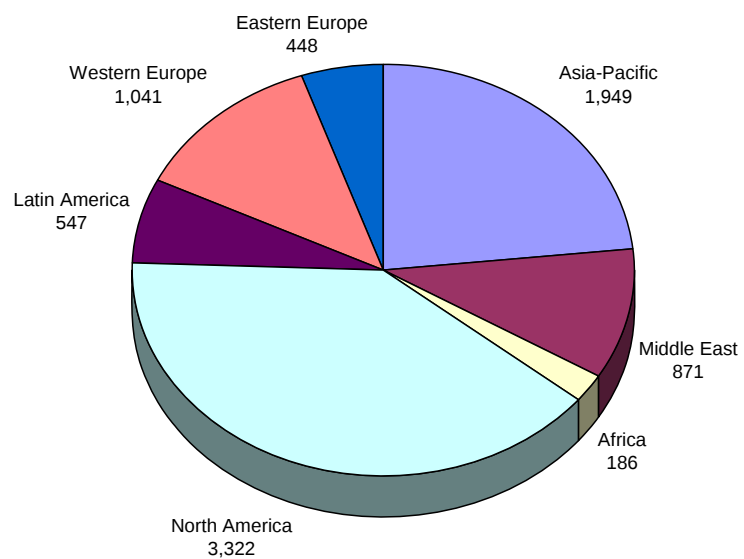


Figure 24. Global ICT spending in mining, 2004 (USDm)

Source: WITSA, the Global Information Economy 2004

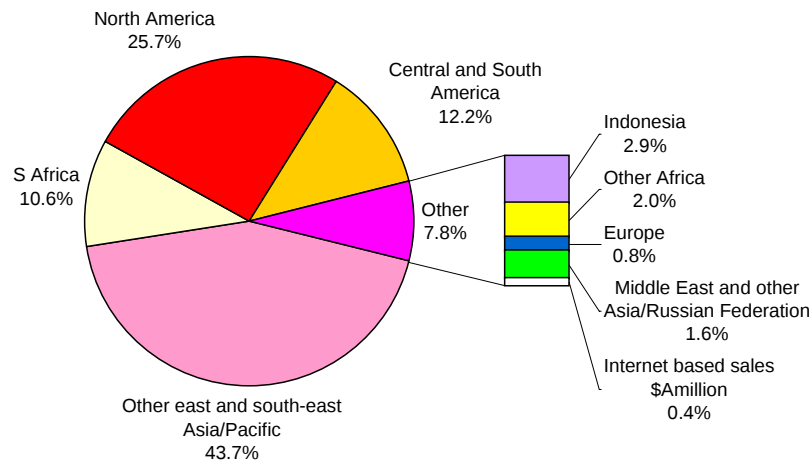


Figure 25. Estimated exports of mining computer services, 2003-04 (share)

Source: ABARE, Mining Technology Services in Australia, 2005, analysed by CIIER.

Mining software suppliers

Gross sales revenue in the mining technology industry is estimated by ABARE at AUD 5600 million.¹⁹⁵ Around 80% of this, or nearly AUD 4500 million, is earned by the sales of mining technology goods and services (including software products and services) to exploration and mining firms. ABARE estimate Australian software products and services global sales revenue for 2004–05 at AUD 565 million, with nearly 53% of this revenue (AUD 298 million) sourced domestically. Such a strong domestic market provides an excellent platform for international sales, while it remains sufficiently important to firms to maintain their Australian presence and headquarters here.

Employment provides an indication of supplier capacity. ABARE estimates mining software firm personnel to number 2100. We consider this may be an underestimate, as firms in the Whitehorse Top 250 database selecting mining as one of their top three vertical markets employed over 6500 staff in aggregate. However, over 5000 of these personnel are employed by firms with a broader portfolio of clients, so the ABARE estimate may reflect only employment within those software firms with a concentrated focus on the mining sector.

Software firms focused on the minerals vertical market in Australia tend to be clustered in the major cities of the states where minerals firms are clustered (i.e. in Western

Australia, Queensland and the Northern Territory). Proximity to clients, both to the administrative offices in the cities, and, depending on the software concerned, to remote sites and exploration areas, is important for success. There are, however, mineral operations in other states, and there are pockets of the minerals software industry in South Australia, New South Wales and Victoria.¹⁹⁶ A significant number of personnel in Australian minerals software firms are also located overseas, in order to be closer to their international clients.

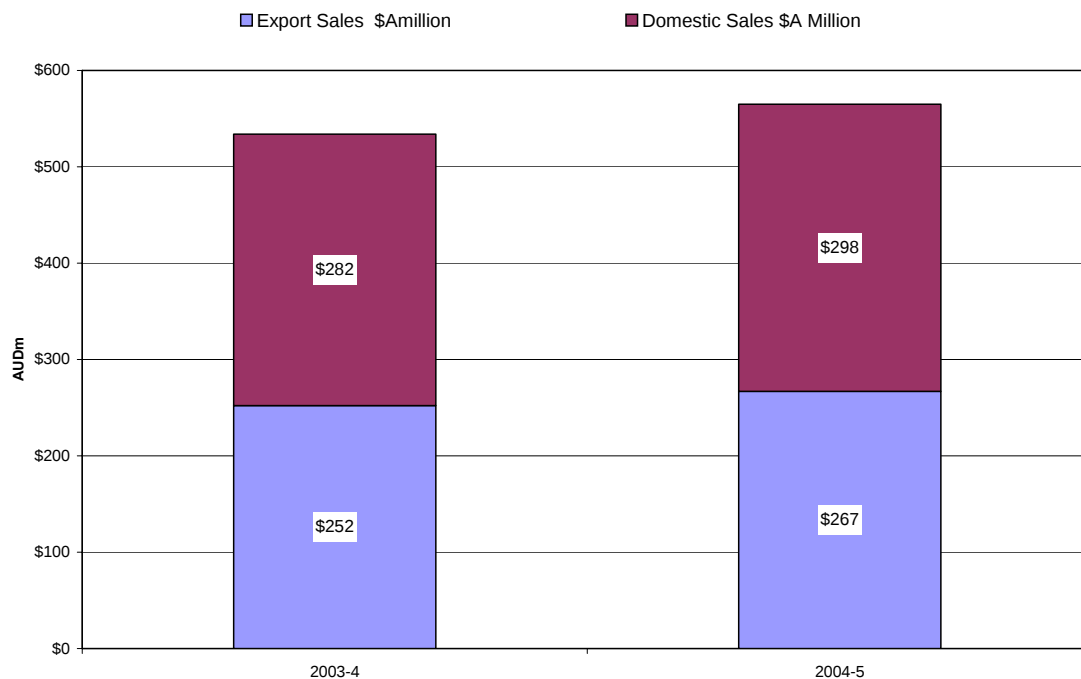


Figure 26. Mining technology services revenues, 2003–04 and estimated 2004–05

Source: ABARE, Mining technology services in Australia, 2005.

Minerals software suppliers

Over the last few years, a number of smaller specialist mining software firms have been acquired or invested in by some of the larger players. Examples of such acquisitions are contained in the company tables below. This consolidation is leading to greater levels of synergy between products, and expanding software product offerings to national and international clients. In a number of cases, the acquired firms continue ‘stand-alone’ operations, but they have benefited from the international market presence of the more established firms.

This activity is not restricted to acquisitions of Australian software firms. For example, Mincom has recently acquired Chilean mining software firm Exedra, and it is possible that this may foreshadow a more focused acquisition strategy by Australian software firms seeking to achieve greater critical mass in key international markets.

In some vertical markets, such consolidation processes have sometimes led to a reduction in the ‘Australian owned’ component of the software industry serving that market.¹⁹⁷ This has not been the case in the minerals sector, due to the lead position held by a number of strong Australian owned firms. International acquisitions by these leading Australian firms should also help to retain this position. However, should one or more of the top three or four firms move offshore, the particular Australian flavour of the mining software industry could prove to be vulnerable.

The table below lists a number of Australian minerals software firms and products. The list is indicative rather than exhaustive. In addition, there are several Western Australian firms developing software for geodata, geoscience and visualisation, including Intierra, Fractal Technologies, Dynamic Digital Depth, ERM, Specterra, Mapinfo and Geosoft. The minerals sector also has its own in-house providers. For example, Rio Tinto Group Corporate Services is based in Perth and manages the network and corporate software for over 30 000 employees in more than 50 countries.

Table 27 Some minerals software firms and products

ADESI	A joint venture between Woodside Petroleum and Accenture that provides SAP applications management services for the resources sector.
Advanced Systems Integration,	In 2002 Maptek acquired ASI, an Australian developer of production management and automation systems. The MineSuite software has a flexible and user friendly approach to the complex issues of real-time monitoring and reporting. MineSuite supports all areas of mining operations from drill and blast through to product delivery.
Applicad Australia	Melbourne, Victorian firm AppliCad is a technical software applications development and marketing firm which specialises in productivity solutions for engineering, architecture and manufacturing. The management team of AppliCad has experience in the use, technical development, sales and marketing of specialist CAD/CAM software. For the last five years Applicad has marketed and distributed CAD applications throughout the America's and Europe and now joins forces with Cad Cam Solutions to offer MineGeo mine site geological mapping software to the mining industry.
ASI Automation	Integrates hardware and software solutions at diverse sites including open cut and underground mines, coal loading facilities and preparation plants. It provides engineering design services, PLC system design and programming, SCADA system design and implementation, and Telemetry systems.
Costing & Logistics Systems	CLS is a privately owned Australian firm providing quality PRONTO implementations to the global mining and contracting industries. Services include PRONTO support and training, report writing, custom development and integration, hardware and communications. PRONTO is a fully integrated management information system comprising financials, fixed assets, tenement costing, contracting, supply, purchasing, human resources and plant maintenance. PRONTO has been successfully implemented at over 50 mining firms
Datamine Australia	Datamine is a world leader in integrated mining software packages currently in use at more than 300 locations worldwide. Datamine is used on deposits from clay, sand, limestone and gravel to iron ore, copper, gold, silver, titanium, coal, bauxite and diamonds. Applications vary from initial capture of data through to detailed planning of open pit and underground mines. Datamine integrates sophisticated data management functions with a wide range of geological and mining applications using interactive graphics and user-definable menus.
I-SiTE Pty Ltd	A subsidiary of Maptek, specialising in the research, development and industrial application of 3D laser scanning technology. I-SiTE develops both hardware and software for collecting and modelling point cloud data. The I-SiTE 4400 Laser Scanner combines laser scanning, surveying and panoramic digital photography. I-SiTE is commonly employed on mine sites for pit survey, stockpile volumes, haul road analysis, stability monitoring, pit production measurement, geological and geotechnical mapping. The I-SiTE Studio software provides tools for editing, registration, manipulation, viewing, modelling and interrogation of dense point data clouds such as laser scans. I-SiTE's Voidworks software works with CMS and CALS data to calculate stope, drive and void volumes
ISS	Has an international market for mine reporting systems such as production, processing, grade control, etc. There are over 100 development personnel there and they have extended into the energy and major processing plant sectors.

Lynx Mining Systems	Primary function is software development, and they are the developers of a suite of integrated geological, mining and mine surveying programs, known as microLYNX+, which cater for the needs of technical people within many of the mining industry's diverse environments.
Maptek Pty Ltd	Has been at the forefront of the development of software for science and industry for more than two decades. Maptek is an Australian firm with an international reputation for innovative software design, committed to providing total mine solutions and helping customers sustain a lasting technical advantage. Maptek employs more than 150 people worldwide, with offices in Australia, US, Chile, Brazil, UK, Turkey, and South Africa. Maptek's VULCAN 3D modelling and mine planning software provides geological data manipulation, structure and attribute modelling, map generation, reserve calculation, mine design, surveying and scheduling. More than 1400 licences of VULCAN are installed around the world in the mining industry.
Metech Pty Ltd	Perth, Western Australia, founded in 1980, provides high level software services and support to the global mining industry, utilising MineSight and acQuire software technology. In 1992, Mintec Inc., an American Affiliate, initiated the MineSight (formerly Medsystem) project. Metech has contributed in design, development and support of this product since this time. Metech currently employs 25 staff, and has regional support offices in Santiago, Chile and in Calgary, Canada.
MicroLYNX+	Used by: exploration or mine geologists, as a geological modelling package; exploration or mine geologists, as a surface modelling package; mine and topographical surveyors, as a survey and surface modelling package; and mining engineers, as a set of mine design and scheduling tools.
MICROMINE Pty Ltd	Products include greenfield exploration through drilling and near-mine development, to back-office data management. 1500 licences are in use worldwide. In addition to core products, Micromine and GPick, the firm offers extension packages for geology, sampling, imaging and air-photo digitising for the industry standard desktop GIS package, Arc/View. Micromine's PitRAM is a computer based mine control package. The PitRAM system is designed to ensure that mining operations run as efficiently and productively as possible. PitRAM is designed to help mining operators and contractors achieve maximum profitability through more effective use of human resources, plant and equipment.
MINCOM Pty Ltd	Mincom has been in business for twenty years and currently operates 30 offices in 18 countries, employing more than 1100 people. Its head office is in Brisbane, Australia Mincom designs and delivers total enterprise applications solutions for capital asset-dependent firms in the mining, utilities, transportation, and government and defence industries. Mincom has developed a technology for mining that will radically lower the cost of mining operations around the world. The breakthrough takes four major Mincom systems and disseminates the resulting data to provide a 'bedrock to boardroom' flow of information. Mincom serves customers in over 40 countries through four business units, providing enterprise applications software, professional services, e-business capabilities through Innotech Solutions, and ASP through Tequinox.
RMT (Risk Management Technologies)	Provide health, safety & environmental (HSE) software locally and internationally. It is 25% owned by BHP.

Runge Pty Ltd	Provides engineering, financial, logistics and IT solutions to the global mining industry. Runge employs over 50 staff and provides specialised technical consulting services and planning services for management, and promotes the Runge software range of computer packages for mine planning, optimisation, management decision support and financial analysis. Runge products and services are applied across a broad range of customer needs in complex through to simplistic operations around the world. Runge software products have been accepted for use in over 25 countries and the firm has permanent offices established to service the Australasian, Americas and African regions.
SDS Ausminco	Ventsim is an underground mine ventilation simulation package designed to simulate airflows (and many other types of ventilation data) from a modelled network of airways. Ventsim is the first ventilation package to integrate an easy to use Windows graphical design with a 3D graphics interface. The software is currently used by over 200 mines, universities, consultants and research organizations throughout the world.
Snowdens	Provide data management services to BHP and have other major outsourcing contracts in the industry.
Softrock Solutions Pty Ltd	West Australian based firm specialising in the development of automated robotic systems for the detection of movement in large structures such as open pit walls, dam walls or in fact anywhere that failure movement needs to be measured.
Surpac Minex Group	Perth headquartered firm providing development and support of mining, engineering and environmental software products. Formed by the merger of ECSI (Minex) and Surpac Software International in October 2002. Over 30 years, ECSI and SSI have a client base of 5,000 users, in more than 85 countries, with seven dedicated firm offices and many global agents. Surpac Vision is a system for ore body evaluation, open pit and underground mine design and production. It is the most widely used system of its kind in the world, with more than 3000 licences sold across more than 80 countries. Minex is the world's leading coal modelling and mine design and planning software solution. Quarry contains powerful tools for quarry design, planning and production. Xplorpac is an exploration product for the graphical extraction of drill-hole sections. Surpac's drill-hole logging products include DrillKing and LogMATE.
VP Technical Mining Solution/Minescape (Mincom)	Mincom MineScape is a suite of integrated mine planning and geologic analysis products designed for use in open cut and underground mining operations for both coal and metalliferous deposits.

Source: CIIER Analysis.

Allocating the firms software products to the main mining groupings (see Table 28) shows the strength of Australian capacity, especially in mine management, exploration, geological survey and mapping, and mine planning.

Table 28. Minerals software firms by area of activity

<i>Company</i>	<i>Management</i>	<i>Exploration, geological survey & mapping</i>	<i>Telemetry</i>	<i>Mine planning</i>
ADESI				
Advanced Systems Integration				
Applicad Australia				
ASI Automation				
Costing & Logistics Systems				
Datamine Australia				
Dynamic Digital Depth				
ERM				
Fractal Technologies				
Geosoft				
Intierra				
I-SiTE Pty Ltd.				
ISS				
Lynx Mining Systems				
Mapinfo				
Maptek Pty Ltd				
Metech Pty Ltd				
MicroLYNX+				
Micromine				
Mincom				
RMT				
Runge				
SDS Ausminco				
Snowdens				
Softrock Solutions Pty Ltd				
Specterra				
Surpac Minex Group				
VP Technical Mining Solution / Minescape (Mincom)				

Source: CIIER Analysis.

Management software is aimed at both general and mining specific administration, and to the particular processes related to mine management. Exploration, geological survey and mapping software relates to all of the spatial management and location analysis data that are inherent in minerals exploration and mine processing. Telemetry is the measurement of almost anything and whilst it is a significant area of minerals IT, most telemetry products in this area use embedded software. Mine planning relates to the specific tasks of establishing mines and to the planning of their technical operations.

Oil and gas software suppliers

The oil and gas industry is dominated by large multinationals. There are relatively few local suppliers of software and services to this sector. There are, however, a number of supportive initiatives for local industry, one of the more significant being the Western Australian Energy Research Alliance (WA:ERA), funded by the Western Australian state government, Woodside and Chevron-Texaco

Oil and gas ICT suppliers tend to focus on seismic processing, well data management or on the support tasks of data storage and tape processing. Seismic data is the oil and gas equivalent of geographic data for mining: it measures and records geographic vibration activity caused by controlled explosions, and assists in the identification and location of oil and gas reserves. Well data management is the oil and gas equivalent of mine management and mine planning. A number of the identified software and related services suppliers are identified below.

Table 29 Some oil and gas software firms and products

<i>Seismic processing</i>	
Australian Seismic Brokers	ASB claim to hold the largest privately owned seismic database in South East Asia with in excess of two million line kilometres of seismic data. Data packages cover all major hydrocarbon producing areas throughout the region including Australia, Indonesia China Thailand and the Philippines. ASB has also established a processing centre in Jakarta, Indonesia with trace reconstruction (hard copy scanning) facilities enabling it to value-add to the data sets in a timely manner.
Baker Hughes	Baker Hughes, a leader in oilfield services, provides technology to find, develop, produce and manage petroleum reservoirs. Baker Hughes is the combination of many innovative companies that have developed and introduced technology to serve the petroleum service industry. Their combined history dates back to the early 1900s. The company is focused on providing drilling, formation evaluation and production technology used within oil and gas wells.
PGS Australia	Petroleum Geo-Services is a technologically focused oilfield service company covering the complete value chain from exploration, via field development to production. PGS operates in two primary business areas, seismic and production, through three operating units: marine geophysical, onshore geophysical, and production. In addition, its reservoir business unit provides reservoir expertise and allows it to exploit synergies across the product lines. The company provides a broad range of geophysical and reservoir services, including seismic data acquisition, processing and interpretation plus field evaluation. In the North Sea, PGS owns and operates four floating production, storage and offloading units. The PGS group employs approximately 3400 people and has offices and operations in more than 20 countries worldwide. PGS revenues for 2003 were approximately USD 1.1 billion.

Robertson Research Australia	Robertson Research Australia (RRA) is part of the Robertson Research International group which provides integrated oil and gas consulting services for new ventures, exploration, appraisal, development and production. RRA in Western Australia is heavily involved in seismic data processing with the main focus being on M2DS, M3D and L2D. It also has a strong Interpretative Services group. RRA has processed data from all marine and land sedimentary basins in Australia and its geophysicists have worked on projects from Brazil to Morocco and from New Zealand to Norway. RRA maintains an active programming and R&D department which supports its proprietary UNISEIS software.
Veritas DGS Australia	Veritas DGC offers the oil and gas industry a comprehensive suite of integrated geophysical services designed to manage exploration risk and enhance drilling and production success worldwide. These services include seismic survey planning and design, seismic data acquisition in all environments, data processing, data visualisation, data interpretation, reservoir characterisation, data archiving and extensive non-exclusive seismic data library surveys worldwide.
Western Geco	Western Geco was formed by combining Geco-Prakla with Western Atlas, the company is owned 70% by Schlumberger, and 30% by Baker Hughes.

Tape transcription services and quality control

Australian Seismic Brokers	see above
Encom Technology	Encom Technology was founded in 1984 to develop a range of exploration software programs which would run on microcomputers. During the 1980s, the business expanded from this original focus to encompass geophysical consulting and data services. Encom is now a leading innovator and major supplier of specialist software, data and services to the petroleum and mineral exploration industries in Australia and many other parts of the world. Encom employs more than 30 people in offices in Sydney, Melbourne and Gosford.
Geocom Services Australia	GeoCom Services Australia Pty Ltd was formed in 1995 to provide advanced workstation services to the Australasian Oil and Gas Exploration and Production industry.
Guardian Data Seismic	see Veritas
Schlumberger Oilfield Services	Schlumberger is the leading oilfield services provider, trusted to deliver superior results and improved E&P performance for oil and gas companies around the world. Through well site operations and in research and engineering facilities, it is working to develop products, services and solutions that optimise customer performance in a safe and environmentally sound manner.
Spectrum Data	Spectrum Data, previously a division of Encom Technology, is the largest data management, transcription and duplication company in the region. Spectrum Data assists Encom on a range of transcription projects where specialist capabilities in seismic, well and navigation data are required.

	Spectrum provides a range of tape archiving, duplication and transcription services; recovery of data from striction-affected and damaged tape; supplies a range of data hardware and media and offers consulting services to help manage data assets.
TGS Nopec	TGS specialises in the design, acquisition and processing of 2D and 3D multi-client seismic surveys worldwide. The company offers an array of complementing services and data products with an emphasis on quality control and verification. A2D Technologies, TGS' well log subsidiary, leads the industry in log holdings and provides digital well log related services and software. TGS-NOPEC provides geoscience data, software and services to energy companies looking to explore a world of opportunities. The company licenses seismic data around the globe, including the two largest 2D surveys ever acquired. TGS holds one of the industry's largest and youngest collections of 2D and 3D multi-client data along with the most extensive online database of digital well logs ever compiled

Physical data storage

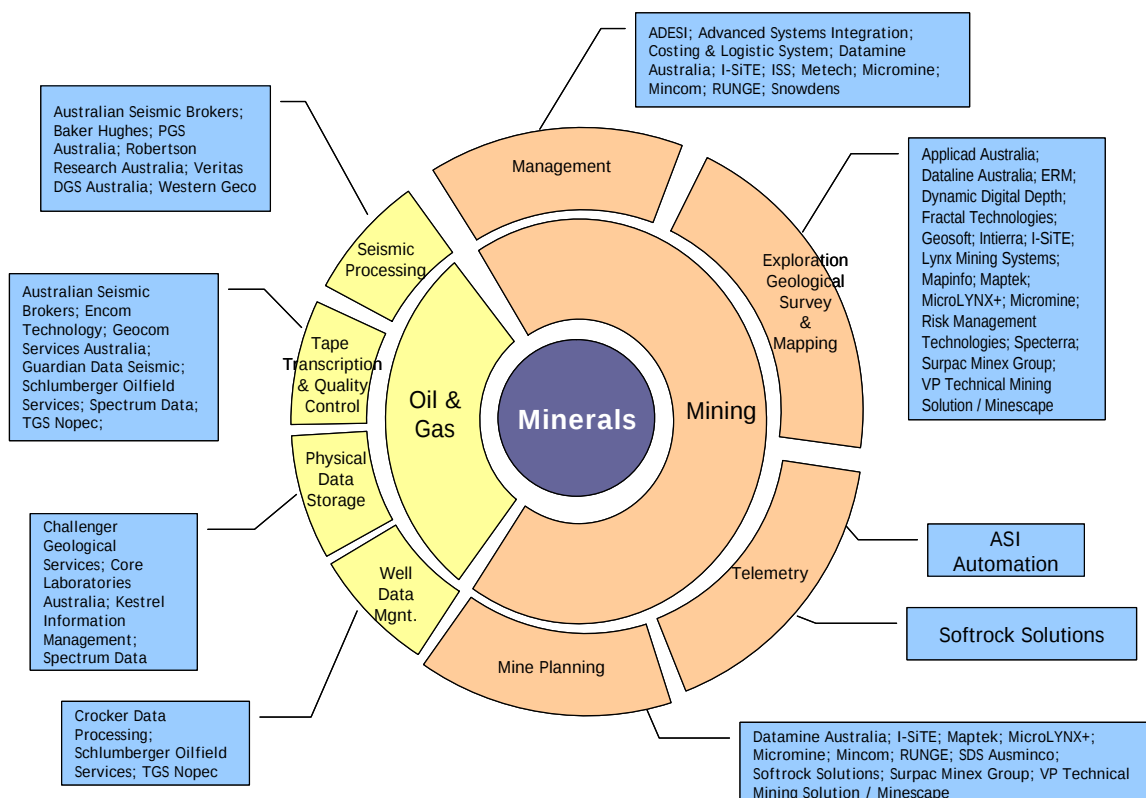
Challenger Geological Services	Challenger provides a range of services including: bagging / identification / re-boxing of samples, Field Exploration and sampling, Core cutting service, Core and rock sample photography, lapping and grinding, re-packaging, etc.; Storage of core, drill cuttings, samples, field equipment, vehicles etc; and Logistical support, sample transport, field activity coordination.
Core Laboratories Australia	Core Laboratories is a leading provider of proprietary and patented reservoir description, production enhancement and reservoir management services for the global petroleum industry. The Company has over 70 offices in more than 50 countries and is located in every major oil-producing province in the world. The Company provides its services to the world's major, national and independent oil companies.
Kestrel Information Management	Kestrel provides secure, offsite storage for exploration data assets and a range of specialised management and administrative services that meet the unique needs of this industry. Kestrel operates multi-client record centres in Australia, Canada and Indonesia. Record centres are conveniently located and provide a secure, offsite storage and management environment for all exploration data assets including hardcopy documents such as reports, well logs, seismic sections and maps, magnetic media and physical data such as cores and samples. Magnetic media is stored in a controlled environment to guard against premature degradation and data loss. Kestrel's IT platform, Loc@te, is a fully configurable IT solution with the capability to customise databases, report and bill to reflect specific customer requirements or to mirror existing customer systems.
Spectrum Data	see above
Well data management	
Crocker Data Processing	Hugh Crocker and Robert Charlebois established Crocker Data Processing Pty Ltd (CDP) in 1983 for the purpose of developing software for the oil exploration and production industry, specifically for well log data interpretation. Crocker and Charlebois are both internationally recognised experts in the field of petrophysics. Combined, they have more than 80

	years experience in the oil & gas industry. Headquartered in Perth, the company also supports bureaus in Canada, Indonesia, Malaysia, Oman, and Pakistan. The company's software, PETROLOG, is specialised advanced log analysis software that performs many of the tasks associated with interpretation and evaluation of well log data. PETROLOG is currently used by more than 200 clients in over 28 countries on 5 continents.
Schlumberger Oilfield Services	see above
TGS Nopec	see above

Source: CIER Analysis.

The minerals vertical software market map shows firms focused on minerals software markets, together with their major areas of concentration. There is clearly greater focus by Australian software suppliers on mine management, exploration and its related fields of geological survey and mapping, mine planning and the processing of seismic and quality data for the oil and gas industry. Perhaps surprisingly, on the information available, there does not seem to be significant 'cross-over' between firms addressing mining, and those addressing oil and gas related markets, suggesting that the technical environments of these market segments may be too internally specialised to encourage broader ranging products.

Figure 27. Minerals vertical software market map



Source: CIER Analysis.

Barriers to growth

A recent report by technology consultants, Ovum, identified some of the concerns expressed by mining software firms. They noted that some Australian mining firms have a predisposition for Australian ICT providers, based on successful relationships in Australia, but that most adopt a pragmatic approach, ‘selecting ICT that is fit for purpose, supported and easy to use in the overseas mining environments concerned’; and that ‘Where Australian mining personnel recommend or directly adopt Australian ICT in overseas mining operations, this typically occurs at an individual level, based on individual networks of contacts, rather than as a result of corporate policies, marketing strategies or systemic approaches to the adoption of ICT’.¹⁹⁸

Ovum noted concerns that there may be a ‘cultural cringe factor’ among some Australian mining firms, suggesting cases where Australian ICT products are only considered after the ICT provider demonstrates sales and successful implementations overseas. They further noted that: ‘Increased globalisation of mining is likely to lead to greater centralisation of purchasing and R&D activities. This will favour the more mature mining ICT markets and providers, as they will already have established a reputation and the resources necessary to undertake major R&D programs. For many Australian firms, increased centralisation could be a positive development, but the benefits will fall disproportionately across the sector’.¹⁹⁹

On threats to future business growth, the Ovum report noted: ‘The major threats to the growth of Australian mining ICT are perceived by the ICT providers to relate to innovation by competitors that results in products superior to those provided by Australian firms... and through scale economies in production, cost control and efficient marketing’.²⁰⁰ While the ‘predisposition to Australian suppliers’ noted in this analysis seems to be contradicted by the ‘cultural cringe’ argument, the two are not necessarily mutually exclusive. It is quite possible that there may be a wish to buy locally that is then impacted by the fear of buying an unsupported or less well-proven product.

Whilst there is no equivalent analysis (that we can identify) addressing barriers or constraints to oil and gas software suppliers, it is probable that similar considerations apply.

Innovation base and support infrastructure

Minerals software companies benefit from both the generic ICT industry innovation base outlined in the earlier part of this report, and from the innovation base for the general minerals industry. This latter includes a significant amount of general minerals research, or minerals market research, at key research organisations, including the following.

- CSIRO (e.g. Exploration and Mining, Minerals and Petroleum Resources Divisions)
- Geoscience Australia

- Australian Mining Industry Research Association (AMIRA)
- Mining Council of Australia
- Australian Institute of Mining and Metallurgy
- ABARE
- Australian Nuclear Science and Technology Organisation (ANSTO)
- Mining Cooperative Research Centres, including the recently announced Sustainable Resource Processing CRC

Some of this research has specific relevance to minerals software development. For example, the CRC for Predictive Mineral Discovery focused on 3D geology, fluid studies, innovative geochronology and computational modelling to help the Australian mineral exploration industry improve its ability to target new ore bodies. It has the potential to provide research outcomes that could be developed into new software products. The question, in common with most other research outcomes from CRCs, is whether relationships exist between the CRCs and the software industry that could assist this outcome. In this context the following quotation from the CRC's annual report is significant.

It is particularly pleasing to have engaged several SMEs as research partners. Geoinformatics Exploration Australia Pty Ltd, a Perth based junior, has commenced a one-on-one project focussed on developing predictive models for discovery of gold deposits in Nevada (USA). Intrepid Geophysics, a Melbourne based SME, initiated and completed a CRC project using CRC data from Broken Hill in collaboration with BRGM in France that developed and evaluated software for predictive geological and geophysical 3D modelling.²⁰¹

A further example can be found in the CSIRO Genesis 2000 project (see box 19).

Box 19 Genesis 2000 project

Genesis 2000 is a software package designed specifically for oil drilling. It draws on information from previous operations, to reduce failures and increase productivity. It yields savings of 4% to 5% in rig-days, with each rig-day valued around \$300,000. The software gives drilling engineers, rig personnel, managers and financial controllers the ability to assess risk, cost wells and modify well plans by capturing technical and financial knowledge from previous wells in order to plan and execute more productive wells in similar areas.

Genesis 2000 was developed in a \$12 million project by CSIRO Petroleum, with six major international oil companies, consultants and an international collaboration of scientists. The Genesis software consists of two elements: the Analyzer, which explores all available data about previous wells in the area, and the Designer, which uses that information to optimise the design of the new well, and to evaluate its time and cost uncertainties. Noble Engineering and Development Ltd, one of the world's largest offshore drilling contractors, is commercialising the technology in an alliance that sees CSIRO retain intellectual property for further development. The benefits to Australia include the creation of two new Perth based companies—Spektl, which will maintain the software, and an agency involved with the commercialisation—as well as a stream of royalties to CSIRO through technology exports.

AMIRA International Limited is an independent association of companies in the minerals industry and provides its services to members in many parts of the world. The core business of the Association is the development, brokering and facilitation of collaborative research projects which are sponsored by members. AMIRA has established a Technology Vice Presidents Forum. In 2004, the forum focused on two topics: 'Strategic Planning of Technology' and 'The Interface of Technology and Policy'. AMIRA's 2004 annual report states that, at June 30, 2004, the Association had 40 projects valued at AUD\$37 Million of industry funding under management on behalf of 68 members and other sponsors from all the major mineral companies in the world. While none of these projects is specifically related to software, many of them could include software elements.

As previously indicated, the oil and gas industry is dominated by large multinationals, and there are relatively few local suppliers of software and services to this sector. The Western Australian Energy Research Alliance (WA:ERA), funded by the Western Australian State Government, Woodside and Chevron-Texaco provides innovation support to this sector. WA:ERA is based at the Australian Resources Research Centre, which is the minerals and energy CRC at Technology Park in Perth. WA:ERA states that it is focused on providing premium quality research and technology-based solutions and education services to the global energy industry, particularly to companies with commercial activity in Western Australia.

WA:ERA plans three core strategic research programs. The programs target key technology challenges for the industry in WA, covering the following.

- Subsurface technologies
- Gas technologies
- Facilities and sub-sea technologies

Detailed program definition is underway, and, following initial scoping, the programs will be refined with input from a cross-section of oil and gas companies prior to confirmation by the Industry Advisory Group in November 2005.

With the core capability established, WA:ERA and industry partners will build on this core with further industry-funded programs in a portfolio of client-specific and joint-industry funded research initiatives, some of which may involve software development.

The overall strength of the Australian minerals industry, and the historical internal training approaches of major companies in the Australian minerals industry, has also contributed positively to the availability of people with minerals software skills and general business skills, some of whom have then moved to minerals software development firms. Study focus group respondents commented upon the high quality of internal training in the minerals industry, and the positive impact that this has had upon the availability of skilled personnel.

Minerals market conclusions

Minerals software is one of Australia's major ICT success stories. Australia has a strong domestic and international market position, with firms ranging from major international players to new emerging start-ups, and many niche firms with very clear ideas about their preferred product range and target markets.

Identified emerging markets in China, India, Eastern Europe and the Middle East are, in many cases, already being penetrated by leading Australian software producers, and the export culture and focus of this part of Australia's ICT industry is very strong.

Consolidation and synergy is taking place, and is likely to accelerate. However, this is unlikely to result in a less competitive marketplace, as new players will continue emerge to champion new technologies or develop new ideas.

A further interesting trend can be seen in moves towards an expansion of target markets outside the minerals industry. Companies such as Mincom are now focusing increasing effort on other sectors, such as energy, transport and logistics, and are swiftly becoming significant suppliers into these vertical markets as well as to their traditional market.

Trade and commerce

The trade and commerce vertical market includes systems that facilitate business transactions and the interchange of goods and services between organisations rather than within organisations. We have chosen to exclude from this market general accounting systems, ERP systems, sales systems, marketing systems and CRM systems.

Trade and commerce market segments include the following.

- E-commerce platforms—includes e-procurement systems, e-marketplaces, electronic bill presentation and payment, business message hubs, and product directories/catalogues
- Payment gateways—includes online payment and financial transaction software suitable for use in e-commerce
- Supply chain and logistics—includes collaborative planning forecasting and replenishment, routing and scheduling, track and trace and RFID (excludes ERP systems and warehouse management systems)
- Customs compliance software—for use by importers and freight forwarders for providing complying customs documentation

Although it could be argued that trade and commerce has more the characteristics of a ‘horizontal’ than a ‘vertical’ market, the purpose of software applications and areas of application are common across sectors and therefore arguably have ‘vertical’ characteristics (e.g. software in the health industry is centred around the patient centric processes, software in trade and commerce is centred around goods, services and financial processes). Additionally, it is viewed as an innovative segment involving a significant number of Australian players, and therefore, we feel, an important one to examine when looking at the Australian software industry.

The trade and commerce software product system

Key features of the trade and commerce software product system include the demand for interoperability and integration, and the importance of lead customers on the demand side.

Developer-client relationships are central, with many systems developments driven by demanding lead customers (e.g. major retailers, manufacturers/assemblers, government agencies, etc.). There is also some mediation, with key developments in electronic equipment (e.g. RFID, EFTPOS, etc.) involving embedded software and a need for related software to be interoperable. Adherence to, and participation in the development of technical standards, including both technology related standards and messaging protocols, is essential. Hence, developer relations with regulatory players are also important.

The increasing incidence and awareness of fraud in online payments has led to a number of initiatives in the area of secure payments, pre- and post-payment. These are being led by financial institutions and those exposed to the fraud economically. These financial players will drive standards development, the direction and pace of change. To be successful, software developers in the e-payments segment will have to work closely with them.

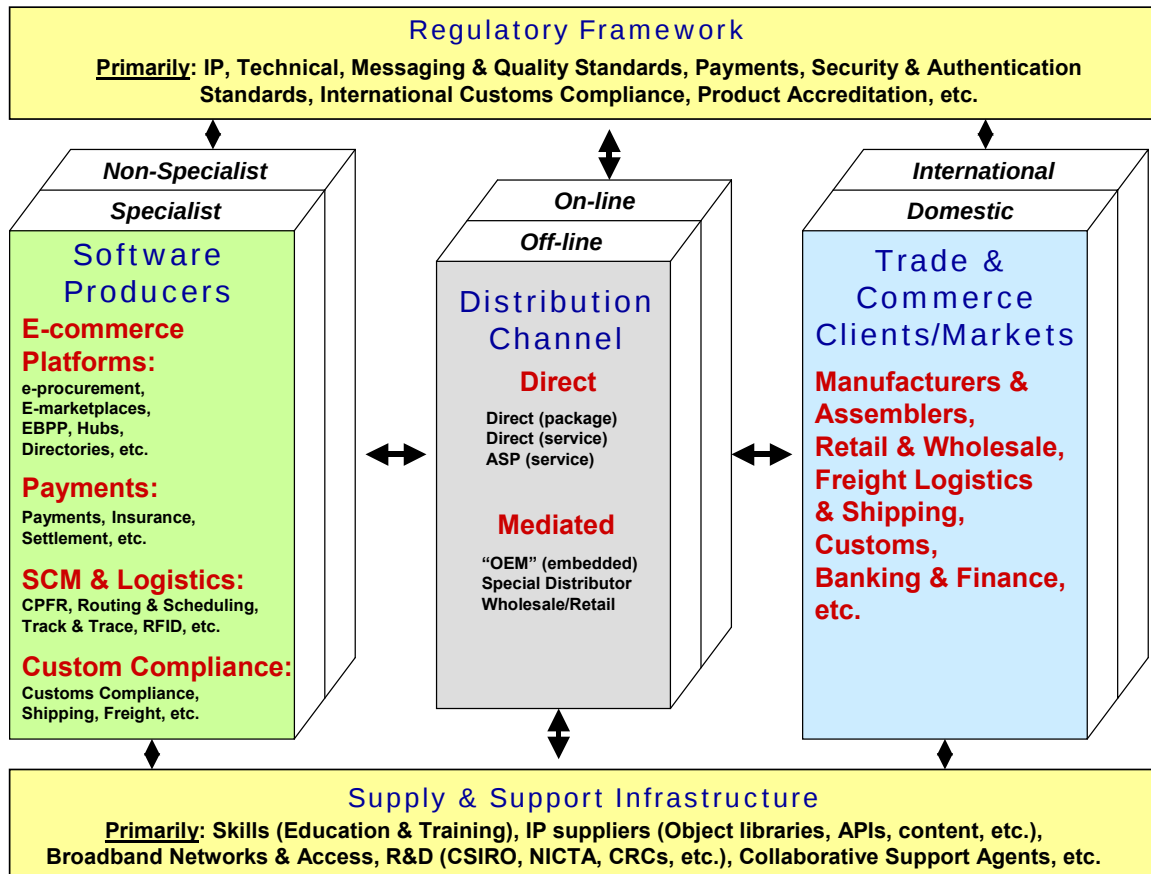


Figure 28 The trade and commerce software product system

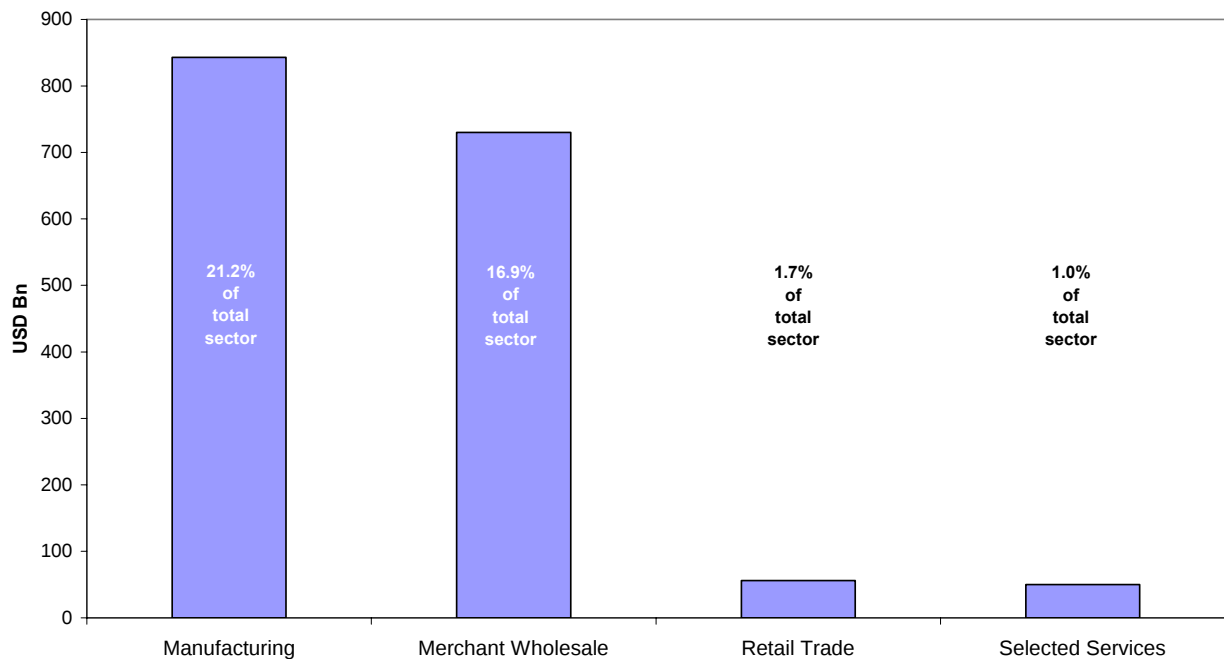
Source: CSES Analysis.

Trade and commerce markets

The US Census Bureau²⁰² reported that retail e-commerce sales (business to customer—B2C) reached USD 19.7 billion for the fourth quarter of 2004, a 22% increase over the same quarter a year ago, and that e-commerce retail was 2.2 % of total retail sales, up from 1.9%. *The Economist*²⁰³ noted that 2.2% is a rather small percentage of total retail sales, although these numbers exclude many important aspects of retail, including travel (one of the fastest growing sectors), ticket sales, financial service, online dating,

gambling, pharmaceuticals and the value of goods sold in online auction sites. As figure 30 indicates, use of e-commerce is also rising rapidly in retail sectors in the US.

Figure 29. E-commerce—value and percentage of transactions sector



Source: US Census Bureau 2003 E-Commerce multi-sector data tables.

However, it is not the value of transactions that is the biggest story of the maturing B2C e-commerce market. It is the influence exerted by a firm's online presence. The Internet is changing consumer behaviour. People are researching their purchases online, even though they may eventually make their purchase offline, and it is this behaviour that is forcing firms to ensure that their online marketing is the best it can be. An effective web presence is often the first point of customer contact.

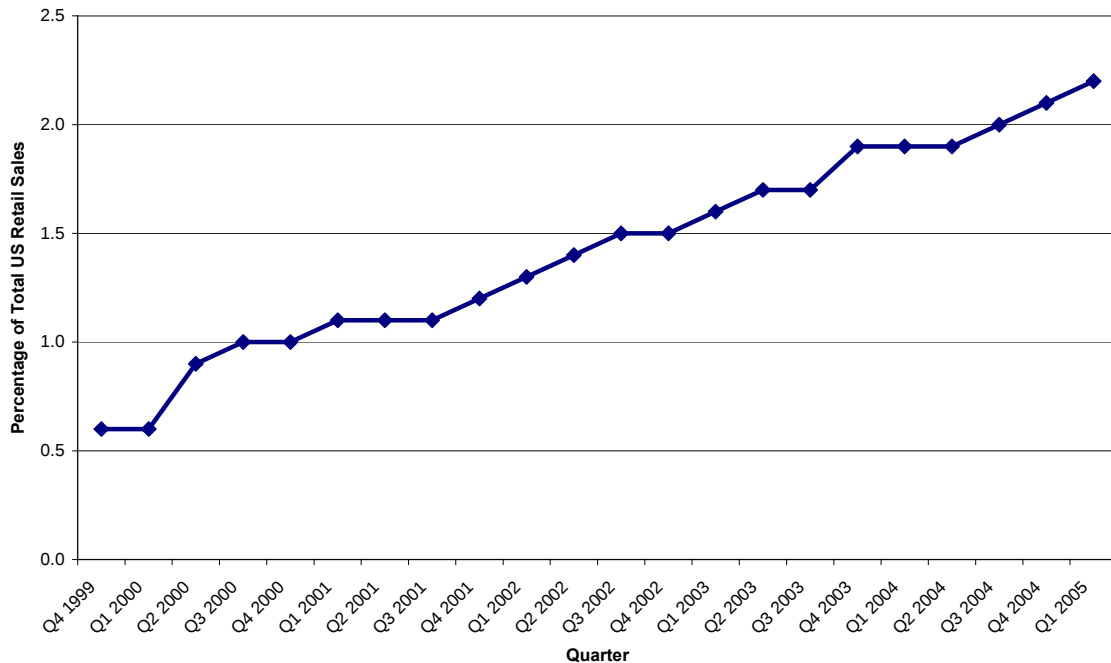


Figure 30. US e-commerce retail sales as a percentage of total retail sales

Source: US Census Bureau Quarterly Retail E-Commerce Sales 2000-2005.

From the US Census Bureau data for business to business (B2B) e-commerce transactions conducted across different sectors of the economy in 2003, it is clear that a substantial percentage of total transactions are now e-commerce based. There is also clear evidence of strong growth in B2B e-commerce. In 2003, B2B transactions in the manufacturing sector grew by 12.1% over the previous year, and merchant wholesale grew by 8.6%.²⁰⁴

The US Census Bureau data also showed a huge contrast between the level of e-commerce in retail (B2C), and that in manufacturing and wholesale (B2B). It is clear that business has embraced e-commerce, with a substantial percentage of total transactions now e-commerce based. B2B e-commerce is growing strongly: in 2003, B2B transactions in the manufacturing sector grew by 12.1% over the previous year, and merchant wholesale grew by 8.6%.²⁰⁵

A study of European B2B e-commerce found that use varied significantly between sectors, with the ICT services sector demonstrating the most sophisticated use of online purchasing and supply chain integration. This study estimated that electronic purchasing plays a significant role in 20 to 25 per cent of all firms,²⁰⁶ but also notes that different industry sectors adopt these technologies at different rates.

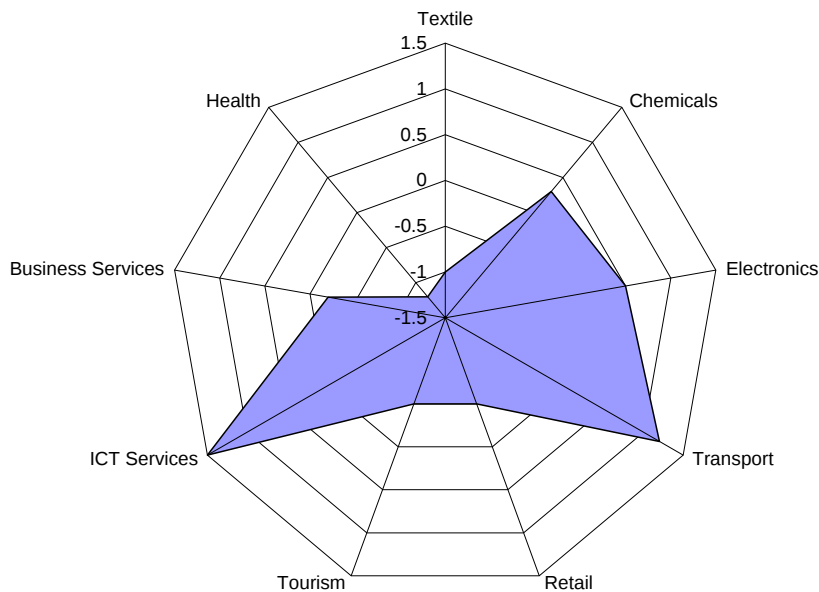


Figure 31. European online purchasing and supply chain index, 2004

Source: European Commission, e-Business Watch, European E-Business Report: 2004.

Note: Index of relative usage -2+2.

In 2002, the ABS examined Australia business use of e-commerce and found that 39% of business had online ordering, 14% had online payment capabilities, 11% offered secure access or transactions (e.g. secure socket layers) and 10% had shopping cart facilities.²⁰⁷ The ABS characterised the general level of sophistication as being fairly low, and noted that the level of sophistication increased with firm size.

Anecdotal evidence suggests that there has not been a dramatic change in the last three years. Consultants with the Australian Retailers Association believe that sophistication in B2B and B2C e-commerce is increasing, but not at a rapid rate, and interest in this area has certainly not regained levels that existed prior to the 2000 'tech-wreck'.

Table 30. Some factors influencing e-procurement in different sectors

<i>Industry</i>	<i>Factor</i>
Chemical industry	Relies on commodity inputs and sells into a competitive market. Margins are low. There is an incentive adopt e-procurement.
Retail	E-purchasing drives vertical integration of players in the supply chain. Firms use it in order to reduce the quantity of goods to be stocked under the same sales conditions, and to accelerate supply flows for improving customer service.
Automotive industry	The automotive industry was forced to develop efficient supply chains during the 80s and 90s. These supply chains tend to be implemented using legacy EDI systems. There is a reluctance to move to newer standards because of the huge investment already made.
ICT services	Able to exploit broadband for direct purchasing online, and immediate receipt of digital goods. This area is a rapid adopter of new techniques.

Source: eBusiness Watch: European Commission, The European E-Business Report: 2004.

Supply chain advances are running up against implementation complexity. The success of organisations like Wal-Mart and Dell has been attributed to their innovative supply chain processes, and many firms have sought to emulate this success. However, the resources and management of complexity required to implement a large scale, enterprise wide supply chain improvement program has slowed growth in this area.

Table 31. E-procurement drivers and barriers

<i>Drivers of e-procurement adoption</i>	<i>Barriers to e-procurement adoption</i>
Price reduction	Inadequate technological infrastructure
Negotiated unit cost reduction	Lack of skilled personnel
Improved visibility of customer demand	Inadequate technological infrastructure of business partners
Reduced administration costs	Lack of integration with business partners
Improved market intelligence	Implementation costs
Reduced operational & inventory costs	Firm culture
Enhanced decision making	Inadequate business processes to support e-procurement
Improved contract compliance	Regulatory and legal controls
Shortened procurement cycle times	Security
Improved visibility of supply chain management	Cooperation of business partners
Increased accuracy of production capacity	Inadequate e-procurement solutions
Enhanced inventory management	Upper management support

Source: ERP Research Group (2002) e-Procurement Practices: An Australian Survey 2002.

In 2003, AMR Research reported that about 65% of large firms have implemented supply-chain software, but less than a fifth of those found that the software makes a huge difference to their businesses. This is believed to be because they have made poor use of their investment and implementation has not been comprehensive. This was

supported by a 2003 Forrester Research survey of 22 business executives from large manufacturing and distribution firms, which found that only 41% have realised a noticeably positive return on investment from their supply-chain management systems.²⁰⁸

A more recent study by AMR Research identified the top 25 firms in supply chain execution, including Dell, Nokia, Procter and Gamble and Wal-mart. They reported that these firms had adopted a more modern supply chain model called Demand Driven Supply Network (DDSN), also called Collaborative Planning Forecasting and Replenishment (CPFR), which better supports flexibility through greater demand forecast accuracy, perfect order fulfilment, embedded product innovation and probabilistic optimisation.²⁰⁹

Box 20. Government initiatives supporting e-commerce

The Australian Government has for some time been promoting the benefits to be achieved through greater levels of interoperability for business.

The Department of Communications Information Technology and the Arts (DCTIA) administers the **Information Technology Online** program (ITOL). Commenced in 1996 it is in late 2005 up to its 13th round of funding, and has allocated more than \$12 million to 110 e-business projects. These projects included such things as: secure freight, a grain supply chain optimisation pilot, and global logistics standards projects.²¹⁰ The most recent allocation included a peer to peer (P2P) supply chain information network for Tasmanian retailers and their suppliers, intended to improve procurement efficiencies between independent retailers and their supply network.

Bizdex is an initiative originally conceived under the auspices of NOIE, but now sponsored by DCITA and Standards Australia. Bizdex is a B2B e-commerce standards framework and set of infrastructure components. The Bizdex framework was validated in 2004 as part of the Grain Supply Chain Optimisation pilot. The project successfully enabled the automated exchange of wheat inventory data, and estimates predict \$2.5 million pa in savings if this were implemented across the whole wheat supply chain.²¹¹ In February 2005, a workshop was held to discuss the experiences of those who were involved with Bizdex projects, with a view to selecting the best strategy. The greatest level of support among the participants was for Bizdex to take on the role of developing, maintaining managing and deploying standards. However, according to the participants involved, there are still several challenges that might hinder the Bizdex initiative. These include securing funding for projects, managing complexity, establishing a critical mass of Bizdex users and involvement of SMEs.²¹²

Source: DCITA ITOL rounds 1–13, and Standards Australia.²¹³

The European e-Business Surveys conducted by e-Business Watch (June 2002 and March/November 2003) show no increase in the overall penetration of supply chain management systems. Supply Chain Management systems were found to be limited to about 2–4% of enterprises, mainly the larger ones, in most of the sectors studied. The studies noted the contrast between the actual Supply Chain Management System implementations and the market research and strategic literature on these software applications, and were inclined to the view there may be an element of hyperbole associated with the literature.²¹⁴

Box 21. RFID: A new component in supply chain management

Radio frequency identification (RFID) has received much attention of late. In the retail industry, RFID's role is typically not as a replacement for barcodes on products, because the barcode technology already functions well at the point-of-sale. Instead, RFID plays a role in the warehouse and in the shipping of cartons of multiple products, allowing retailers and suppliers to track the location of product through the supply chain.

In Australia, the retail industry has been slow to adopt RFID, and Woolworths has indicated that other initiatives demonstrate a more certain business case. Other sectors, such as agriculture and mining, are reported to be further advanced with RFID, with a good deal of pilot activity being conducted 'behind closed doors'. Adoption of RFID in Australia may now accelerate due to the approval in July for the use of increased power (4 Watt) RFID readers by the Australian Communications and Media Authority (ACMA).

However, RFID brings with it implementation challenges, including data ownership, partner data integration, data security and privacy, integrating data across multiple facilities and managing large volumes of data. These realities are likely to lead to somewhat slower adoption of systems than some have predicted.

Sources: Australian Retailers Association²¹⁵, Supply Chain Review²¹⁶, and Abbot, Mandrot and Moore (2004)²¹⁷.

Nevertheless, the need for supply chain visibility is increasing due to the following.

- Greater financial and non-financial accountability, in the US and elsewhere, as a result of the corporate collapse of Worldcom and Enron, and the consequent introduction of the Sarbanes-Oxley Act, CLERP9, etc
- Global security concerns and the threat of terrorism—increasing the need to be able to accurately trace the provenance of goods, and the need to change sources of supply and divert product in the event of disruption caused by unforeseen acts
- Increasing global trade, especially with the emergence of China as a source of manufactures supply²¹⁸

Globalisation and the increasing need for global integration of supply chains is the main underlying driver.

There have been some high-profile supply chain projects conducted in Australia. The two large retailers have been spending hundreds of millions to improve their supply chain information and achieve better supply chain collaboration, but according to Justin Grieg, a director in supply chain management at Capgemini, most suppliers and manufacturers have been unable to fully integrate, and only use the CPFR data provided by retailers in an ad-hoc way.²¹⁹ This has led to frustration on both sides.

There are still comparatively few instances of wide scale implementation of supply chain enabling technologies, such as product information management, global data synchronisation and CPFR solutions, in Australia.²²⁰

Part of the problem lies in inconsistent approaches to business processes and standards on the part of both end-users and developers of software. 'We need to educate the

software vendors on what the market really needs, and we need to be able to help the end-users to fully understand their own requirements and to document these in a way that is standard and consistent across industry. This will help software vendors to work toward the interoperability we need.’²²¹

In the health sector, the Australian Health Ministers Advisory Council (AHMAC) has been sponsoring the National Supply Chain Reform Task Force (NSCTF) since early 2003. This has focused on analysing the needs of the health supply chain, creating standards and encouraging pilots. One of these pilots in Victoria, focussing on trialling improvements in the pharmaceutical supply chain, experienced problems associated with business process complexity.

While the results of this demonstration indicate that the pharmaceutical suppliers are yet to experience the full benefits of e-commerce implementation..... It is clear that a significant amount of work was achieved in bringing the parties to the current stage of the project, and due to the pressures of time, staff resources and budget, most of the parties chose to overlay new technology on existing business processes.

As a result, data gathered by the participants during the period of the demonstration project did not indicate any significant improvements to current manual processes. During the live period of the project, suppliers recorded increased order processing times and minimal changes to accuracy. Whereas the receiver noted distinct increases in the speed and accuracy of goods received. This result alone provided the basis for future full-scale adoption of this technology throughout Southern Health.²²²

The fact that close to three years has already passed since the inception of the NSCTF, with little sign of broad adoption, is testament to the underlying problem facing sophisticated and broad scale supply chain implementations: complexity.

In May 2005, the World Customs Organization released a framework of standards designed to secure the global supply chain in response to the growing threats of international terrorism, organised crime and commercial fraud. The standards consist of the following elements.

- Harmonising the advance electronic cargo information requirements on inbound, outbound and transit shipments
- Countries joining the framework committing to employing a consistent risk management approach to address security threats
- Exporting nations, at the request of destination countries, performing outbound inspection/x-ray of cargo deemed to be high risk
- Businesses which comply with supply chain security standards receiving benefits from customs

As a consequence of increased global security concerns, the Australian Government conducted the Maritime Security Review in 2004. One outcome was that Australian

Customs was appointed lead agency to develop a standardised data set, which also involved 59 government and 30 industry stakeholders.

The aim of the project is to deliver an Australian customs data set that is harmonised with world customs nomenclature, with the ultimate intent of creating more visibility and interoperability of the customs process. The dominant trend occurring in this area is increasing demand for more rigorous and authenticated customs documentation to comply with a worldwide tightening of controls.

The Australian Customs Service has also been running a project known as the integrated cargo system (ICS) for close to a decade. The \$200 million project released its import component in October 2004, and after several delays final cutover for the export component is due in October 2005.²²³ This project demonstrates the indirect linkages that can occur between software producers and government when governments implement large scale centralised processing systems. In effect, the Customs Service, by implementing ICS and requiring more automation, has created a demand in the user community for software to fulfil this automation need requirement.

The trade and commerce software market

Major applications areas include: e-marketplaces, electronic bill payment and presentation, e-payment, supply chain and logistics systems, and customs compliance. Each is discussed in turn.

We define e-commerce platforms as those systems that enable and mediate the process of business interchange between organisations by electronic means. This includes e-procurement systems, e-marketplaces, electronic bill presentation and payment (EBPP) and business messaging interchange hubs.

E-marketplaces

Until the bursting of the Internet bubble, e-marketplaces were one of the darlings of the new economy. Stock prices of firms such as Ariba and Commerce One were astronomical. By late 2004, however, Commerce One was on the verge of bankruptcy, and Ariba was forced to change direction and become a web services company.

In 2000, Boston Consulting Group predicted that the US B2B market would ultimately be characterised by a handful of e-marketplace giants that served the overall needs of an industry, and scores of niche players serving a special segment within an industry or providing a specialised function across many industries. This has not materialised, with e-marketplace success being more modest than expected.

By 2003, AMR Research reported that the trade exchange market was a mere USD 798 million, out of a total potential market of USD 47 billion. Forrester have observed that the survivors are engaging in mergers and acquisitions in an attempt to extract more value, and noted that industry specific vertical e-markets are no longer such compelling investments, suggesting that they are slowly morphing into businesses offering transactional hubs or geographical based markets.²²⁴

In Australia, high-profile marketplaces like Cyberlinx and Corprocure have stumbled, despite the involvement of large corporate players, and have demonstrated that the initial promises about demand aggregation were difficult to achieve in practice. By November 2004, five of the seven leading corporations involved with Cyberlynx had exited. However, Corprocure has realigned its market strategy away from large corporate enterprises to smaller business, and clients are using it to transact business in excess of \$50 million per year.²²⁵

Government e-procurement initiatives have not met early expectations either, with take up of initiatives such as NSW Smartbuy, Victoria's EC4P and Western Australia's GEM being lower than anticipated.²²⁶ The problems appear to have been related to the complexity and cost of integration, the difficulty of properly redesigning business processes and a lack of certainty regarding standards. Commenting on e-government and e-procurement, Nicholson (2004) noted that:

Because we're working in a devolved environment, agencies have to move forward in a way that best suits them. The business case has been tricky to develop for some of the agencies.

I don't see any diminishing of the enthusiasm for e-procurement as a different way of doing business. I just think we're looking at it now with the benefit of four years' worth of hindsight and thinking about how we might go forward to pick up the best benefits – without going down the same approach as we did four years ago. We're keen for this review to roll forward on an evidence basis rather than going forward on any preconceived notion.²²⁷

The news is not all bad. E-procurement is a growing phenomenon, and e-marketplaces are a vehicle for achieving this, but not the only vehicle.

The European Commission's e-Business Watch reported that more than 50 per cent of firms (by employment share) were purchasing supply goods and/or maintenance, repair and operational (MRO) goods online, through their suppliers' websites, Internet trading platforms and/or dedicated firm-to-firm connections (i.e. EDI and extranet). They concluded that: 'Electronic business is gradually coming of age. The business implications of information and communication technologies were commonly over-hyped during the boom-phase of the Internet economy, but possibly under-hyped during the subsequent bust-phase. Having experienced the extremes, it appears that the time has come for a clearer, more realistic perspective and assessment.'²²⁸

Electronic bill payment and presentation (EBPP)

EBPP is a technique available in both B2B and B2C for displaying invoices online and receiving payment. This can be done directly by the biller themselves or via an aggregator. Despite the competitive advantages EBPP can bring, growth of the market has been below expectations.

In 2004, Datamonitor estimated that EBPP accounted for less than 10% of all US bills, despite the US being the leader in this area. In the UK, EBPP solutions have yet to catch on, with less than 1% of all bills delivered and paid online. The differences between US

and European adoption rates is put down to existing payment infrastructures. Direct debit, for example, demands minimum effort from consumers and is cheaper than online payment processing. The advantages to the biller of targeted marketing and cross selling were slow to be realised in Europe.

Frost and Sullivan predicted that by 2010, more than 50 per cent of bills will be paid electronically, which is an enormous increase from the current estimate of 10 per cent. They suggested that: both e-bill presentment and electronic transactions were growing at over 40% annually, whereas billing solution vendors' revenue is increasing by just 15%. This creates a market environment where average prices are rapidly decreasing. However, vendors can resort to automation to overcome this challenge and achieve economies of scale.²²⁹

Table 32. Australian firms in the e-commerce platform segment

<i>e-Commerce Platforms</i>	
Commsecure	Originally developers of e-commerce gateway software have expanded to provide EBPP and share/stock exchange software
Leadtec Systems Australia	Developers of EDI and e-business message translation software and operators of business message exchange hub
Marketboomer Pty Ltd	Market Boomer is an Australian e-marketplace operating chiefly in the hotels procurement industry
NEC (iSolutions) Australia	Owens and operates an Australian developed EBPP solution in conjunction with the ANZ Bank
Pacific Commerce	Developers of products catalogue management software and operators of an e-procurement/ marketplace/hub
Strategic Ecommerce	Developers of web based e-procurement systems and tender management portals

Source: CIIER Analysis.

The Australian firm Commsecure has annual revenues between \$3 million and \$4 million, and is seeing increased interest in their EBPP platform. Their business strategy involves increasing their customer base and earning their revenue from a transactions fee base,²³⁰ a strategy that appears common for developers of web based software. Leadtech began as developer of EDI message translation software for EDI-VANs, and have migrated their business into a full end-to-end e-business hub providing message translation and catalogue hosting services.

Leadtech provide business messaging capability to several large retailers, including Coles Myer and Woolworths, as well as having a technology relationship with GS1 Australia (formally EAN Australia), an important non-profit standards body and provider of independent e-commerce infrastructure in several sectors, including retail and health. Market Boomer and Pacific Commerce both offer e-marketplace solutions

and both focus on servicing specific industry verticals, including hotels, health, timber and hardware, and electrical wholesale. All of these companies appear to have adopted, at least in part, a transaction fee based revenue model.

Payment gateways

This segment consists of systems and technology that is designed to facilitate the transfer of funds, credits or other financial instruments in an electronic manner during the course of business transactions.

In 2004, Select Communications predicted that the revenue of US payment gateway firms would grow by 18% a year. A number of large US-based firms have entered the payments gateway space. eBay has for some time been successfully promoting its 'Paypal' product, and in June 2005 they expanded the service to combine the features of a merchant account with the Payment gateway capability of Paypal;²³¹ and the *Wall Street Journal* reported that Google will be entering the market soon with an offering similar to Paypal.²³²

According to research firm Atlantic ACM, the prepaid mobile phone market in the US is growing at an annual rate of 20%.²³³ They predict that hybrid plans that offer a mixture of pre and post pay will generate two-thirds of mobile phone revenue by 2009. US firms offering some alternative methods include eChecks.com, who offer US customers electronic cheque capability or bill-me-later which allows customers to pay online without using a credit card. It is likely that desire to offer more choice and greater flexibility in payment options will drive a number of solution types in this area.

A 2002 Gartner survey found that fraudulent transactions comprise 1% of total online transactions, 15 times higher than fraud in the physical world. A more recent report in Germany found that fraud in Europe was on the rise: 'The share of charge-backs, resulting from manipulated credit card data, has risen from just over 4% in 2003 to more than 7% in 2004. This is presumably due to the overall increase in organised credit card fraud.'²³⁴ This problem, which is a threat to e-merchants, has resulted in programs sponsored by such players as Visa and MasterCard, where a greater level of buyer authentication takes place. Visa's program is called Verified and MasterCard's program is SecureCode. New buyer authentication programs mean that e-merchants can shift the liability for the transaction to the card issuer.

Verisign, among others, is taking advantage of this and offering a service it calls its 'fraud protection service', which uses pattern recognition and filtering techniques to identify suspicious shopping patterns. It gathers this data from all the e-commerce transactions that Verisign facilitates.²³⁵ The Verisign service integrates with the Visa and MasterCard buyer authentication programs. Australian firm, Creative Digital Technology, is also offering support for these programs with its ActiveAccess product. It appears that anti-fraud measures are becoming more sophisticated as the impact on e-merchants has become greater. Banks and credit card firms are the leading players in the area, as it is they who must agree on standards and common approaches for any technology to be broadly usable.

On the Australian scene, there seem to be a number of players either offering payment gateway software as a product, or offering a payment gateway service and taking a fee based on transactions over the Internet. As companies like Paypal and Google standardise their offerings and improve their relationships with banks, providers of conventional web based payment services would be expected to face increased competition.

Bill Express (formally OnQ) is an interesting example of a company heading in a different direction, by developing its own software in order to own and operate its own payment networks. They have successfully set up a bill pay network in competition to the banks and Australia Post, and provide their own network of terminals to newsagents and petrol stations to conduct transactions and recharge pre-paid mobile phone cards. This is an example of a software company that has moved away from its historical role as a developer of point-of-sale software into a new business where the competitors are large but may not be so innovative.

Table 33. Australian firms in the payment gateways segment

<i>Payment gateways</i>	
Bill Express	Bill Express provides a national payment network service in competition with Australia Post and Banks. Although not strictly a software company, it does develop its own billing systems and embedded software for payment terminal equipment
Camtech	Developers and operators of e-commerce payments gateways and merchant server software
Creative Digital Tech	Developers of payment gateway software and associated software
Ctel	Developers of payments gateways, pay-by-phone, Interactive voice response technologies
FNS	Developers of banking financial gateway products and other banking and treasury software
GBST Holdings	Developers of transaction technology for the financial services industry
Secure Pay	Providers of payment gateway technology and services for B2C web sites and other businesses
Web Active Corporation	Providers of payment gateway technology and services for B2C web sites and other businesses

Source: CIIER Analysis.

Supply chain and logistics systems

Supply chain and logistics systems cover such systems as: collaborative planning forecasting and replenishment systems, routing and scheduling, track and trace, freight forwarding and RFID. These systems are used to manage the movement of goods between companies and countries, and ensure that supply and movement of goods matches as closely as possible the demand for them.

ARC Research's definition of supply chain management includes all supply chain planning, collaboration and execution applications. According to ARC, the SCM market totalled USD 5.1 billion in 2003, and is expected to reach USD 7.4 billion in 2008, a growth rate of 7.4%. This follows a downturn in spending on SCM technology over recent years, due to the economic downturn.²³⁶

In December 2003, IDC reported that the Australian supply chain management (SCM) solution market was worth \$321 million, of which software accounted for \$119 million and services \$202 million. The year-on-year growth rate for the market was forecast at 7.1% from 2003 to 2007. They noted that:

The most pressing needs are to reduce complexity, and ensure a quick ROI. For Australian enterprises employing SCM, the goal is to remove delays in executing, speed up decisions and reduce inventory. However, SCM is simply an enabler, not a silver bullet – SCM technology alone will not be enough to achieve this goal, and can't transform an enterprise simply by its deployment.²³⁷

Marketstrat reported that the worldwide RFID market was USD 1.5 billion in 2004, of which 9% was software related,²³⁸ and Datamonitor predicted that by 2010 the market will be worth USD 6 billion. Germany and the United Kingdom are expected to be the dominant European countries for RFID from 2004 to 2010. In the Asia-Pacific region, Japan's historic strength in manufacturing, its upbeat approach to manufacturing and the use of technology therein, means it will be a key country in the adoption of RFID. While Japan's market share is currently twice that of China, China is expected to overtake, with a share of 33% after 2009, compared to Japan's 28%.²³⁹

Two Australian companies in this segment are notable for their approach to developing an Internet based offering within this segment. Moveit have developed an Internet based supply chain and logistics tracking system, and Pangaea a freight forwarding hub. Pangaea appears to be achieving some success internationally and claim users in over 70 countries.²⁴⁰

Internationally, this market is dominated by large well funded organisations, such as Oracle, i2 Manugistics and Descartes, which offer enterprise systems to corporate clients rather than provide a shared, web-based transaction model as do Moveit and Pangaea. These two models may converge over time, and those smaller players that can successfully secure a broad customer base within a specific functional niche may find themselves a desirable acquisition target for the bigger players in the future.

Table 34. Australian firms in the supply chain and logistics segment

<i>Supply chain and logistics</i>	
Eagle Datamation International	Developers of logistics management systems and customs shipping documentation systems
Civica	Civica develops software in several vertical markets including an international freight forwarding package known as FreightPac.
Moveit	Developer and operator of an Internet based supply chain and logistics track and trace systems
Mercury Advisory Group	Developers of web-based collaborative 'order-to-door' global supply chain and customs interfacing management system
Pangaea Software Pty Ltd	Developers of a web-based freight forwarding hub
Pulse Logistic Systems	Developers of warehouse management, cargo and logistics systems
Mid-Comp International	Developers of integrated accounting/warehouse management/supply chain management procurement systems

Source: CIIER Analysis.

Customs compliance

These systems handle the documentation and interfacing with government required for international trade, including goods classification, customs documentation, quarantine documentation and tax declarations. There can be overlap between these systems and supply chain systems, with some companies offering combined solutions.

It is difficult to identify the size of this segment, but an examination of software producers linked from the Customs Brokers and Forwarders Council of Australia²⁴¹ and the Australian Customs Service websites²⁴² reveals that by far the majority suppliers in the Australian marketplace are indigenous firms. This may be because the market is geographically fragmented, and a similar situation would apply in other jurisdictions.

The trend toward increasingly rigorous customs regulations, spurred on by the threat of terrorism, coupled with implementation of automated central solutions for customs agencies and harmonised customs practices between countries, implies an opportunity for well resourced software providers with a sophisticated product offering to enter other markets. Several Australian firms have established exports markets, primarily in New Zealand and South East Asia.

Foreign competitors include: Kewill (UK), Sterling Commerce (US), Transaxiom (Denmark), Crimson Logic (Singapore) and Descartes (Canada). Kewill Systems seems to be one of the dominant players in this segment internationally. They have annual revenues of GBP 21 million, their software integrates with Fed-Ex and DHL, and

through acquisition they have upgraded from an outdated EDI platform to an Internet based platform.²⁴³

Table 35 Australian firms in the customs compliance segment

<i>Customs Compliance</i>	
Eagle Datamation International	Developers of logistics management systems and customs shipping documentation systems
Digerati	Developers of software for ensuring compliance to import, export quarantine and taxation documentation, and for classifying exports products
Hi Tech Freight Solutions	Developers of freight forwarding software and integrated accounts for small exporters
Impex Docs	Developers of software products to facilitate documentation and interaction with customs for international trade
Mercury Advisory Group	Developers of web based collaborative 'order-to-door ' global supply chain and customs interfacing management system
Oz Docs International	Developers of software for generating customs and freight forwarding documentation
Trident Global	A service and software firm offering customs documentation and freight forwarding data interchange capability

Source: CIIER Analysis.

Companies such as Kewill appear to have significantly more scale than their Australian counterparts, but appear to be focused on the US and European markets. If Australian firms chose to compete directly on the competitor's home turf they may face tough competition, though the fragmented jurisdictions may provide some protection in the short term. A strategy of entering less competitive markets like South East Asia could be a beneficial alternative for some firms.

Trade and commerce software suppliers

The following table summarises market trends and the status of developments in the major market segments. It is followed by the trade and commerce vertical software market map, showing a small indicative sample of firms active in the market, segment-by-segment.

Table 36. Summary of trends and status of market segments

<i>Segment</i>	<i>Market outlook</i>	<i>Competition</i>
e-Commerce Platforms e-Procurement Systems Marketplaces Electronic Bill Presentation Business Message Hubs Product Directories.	There is steady growth in this market, with people's buying behaviour more and more relying on the Internet. However, e-Commerce platforms are still looking at significant consolidation as they attempt to find a profitable niche in a complex area. There is an increasing awareness that effective e-commerce builds on effective internal processes, so there is focus on processes within the enterprise, rather than on collaboration with others at present.	There are significant numbers of competitors in this market, but many firms have struggled to survive. Therefore, business strategies focus less on obtaining market share and more on consolidating current positions or readjusting business plans. Global Exchange Services and Vision Information Services are examples of foreign owned entities competing in the Australian Marketplace.
Payment Gateways	Payment Gateways have also enjoyed steady but not spectacular growth, but there is a growing trend to offer different online payment solutions than traditional Credit card payments. There are also concerns about Internet fraud, which will have overall structural ramifications as Banks and Credit card firms look for broad interoperable solutions.	This market is becoming increasingly the domain of large players such as eBay, Verisign and soon Google, with newer players coming on the scene offering alternatives to traditional credit card payments.
Supply Chain and Logistics Collaborative Planning Forecasting and Replenishment Routing and Scheduling Track and Trace RFID	Despite the sometimes disappointing results of Supply Chain improvement programs, due to implementation problems, there will be continued slow growth in the market as a result of commercial pressures from large customers like Wal-Mart and the needs to ensure security of supply as globalisation increases.	There are significant competitors in this subsector (e.g. Oracle, i2, Manugistics, Descartes and Kewell Solutions). Most are US based. The US is the world's leader in supply chain best practice.
Customs Compliance: Software for use by importers and freight forwarders for providing complying customs documentation.	This is an emerging market, and is presently somewhat fragmented due to differing Customs requirements in different nations. The new World Customs Organization's harmonisation standards will create greater opportunity in this area.	Competition is fragmented with some larger players, such as Kewell Solutions, but no apparent dominance. Crimson Logic and Transaxiom are foreign players in the Australia market.

Source: CIIER Analysis.

Box 22. Innovit Pty Ltd

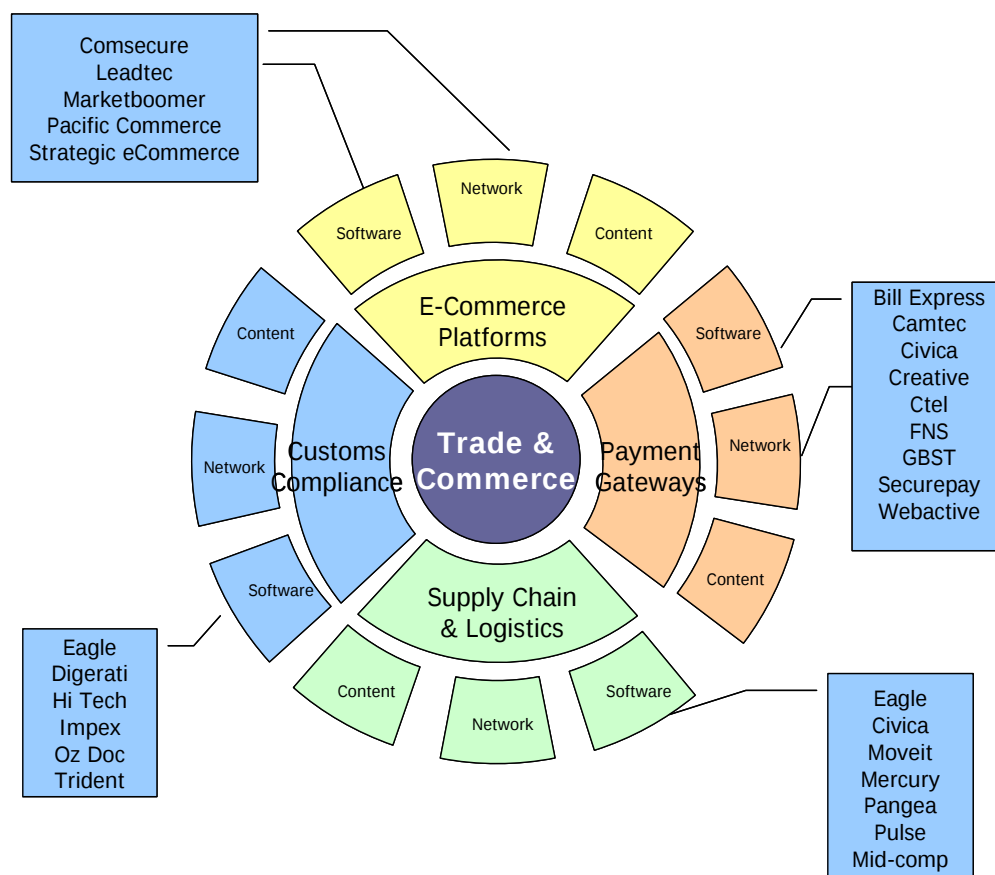
iICE enables the sharing of product catalogues across disparate system platforms, diverse industry standards and different media, thereby eliminating the need for manual reprocessing as product information moves through the supply chain. This enables organisations to generate cost-savings of up to 80% in merchandising, product management, sales analysis and advertising and to improve the integrity, synchronisation and usability of product data.

The development and commercialisation of this innovative product suite has been accompanied by numerous accolades, including the 2000 Yellow Pages Small Business Ideas Grant, the Silicon Valley Mission Competition and the prestigious Australian Technology Park/UNSW Vice-Chancellor's New Business Creation Prize.

Incorporated in 1998, Innovit is a leading provider of product data management systems to the retail, wholesale and manufacturing industries. Innovit's innovative suite of iICE products are designed to help improve the way enterprises maintain, store, and share product data among divisions and trading partners. Innovit's experience extends across a broad range of vertical industries and their wealth of industry-specific knowledge allows them to formulate strategies that help their clients manage, customise, and distribute product information in cost-effective ways.

Source: DCITA (2005) *Secrets of Australian IT Innovation*, Department of Communications, Information Technology and the Arts, Canberra

Figure 32. Trade and commerce vertical software market map



Source: CIIER Analysis.

Innovation base and support infrastructure

While trade and commerce related research is taking place in publicly funded research institution, the linkages seem to be mainly with users and end clients, rather than with software companies in this sector. Among other projects, the CSIRO's Department of Mathematical and Information Sciences has a program looking at Supply Chain technology called 'adaptive supply networks'²⁴⁴ that utilises sophisticated mathematics to solve supply chain problems.

This has includes development of software to manage the complexities of supply chain optimisation for a wine producer.²⁴⁵ However, there does not appear to be any relationship in place with a commercial Australian software developer to productise this expertise.

The government sponsored Bizdex program has the potential to be a catalyst for great change, as it would require the adoption of sophisticated web services and catalogue synchronisation techniques. We consider that the low rate of large or even medium scale adoption of Bizdex in the business community suggests that the obstacles facing its broad acceptance remain. It could be a valuable lesson for those Australian software producers operating in this segment, and for the government, to obtain a good understanding of why Bizdex's progress appears, from our analysis, to be so constrained.

In general, it seems that Australian software developers in this segment rely on their own resources as a source of innovation. Change can come from government, as in the case of new customs legislation, but it is driven primarily by the imperatives of business and the dictates of large players, such as banks, large retailers and so on. Thus relationships with these entities are a key source of innovation and ideas. However, those relationships are often controlled by the large MNCs, which may explain why many of the small Australian software companies in this segment are focused on exploiting niches.

Trade and commerce market conclusions

Opportunities in the trade and commerce vertical market have slowed considerably since the days of the tech boom, and do not yet appear to have returned to pre-bust levels. There has been a maturing in the segment, as firms have discovered that implementation difficulties and internal business process problems have meant that expensive investments in e-commerce platforms and supply chain technology have not delivered the anticipated results. The markets are experiencing positive growth, but it is not spectacular.

Australian firms looking for large growth in the e-commerce platform area, payments gateways, and supply chain and logistics will face difficulties, given that they will be competing against foreign firms that often have greater experience with, and exposure to the most demanding clients and markets.

There is no evidence to suggest that the e-marketplace, e-procurement and transactional hubs market segment is set for dramatic growth. All indications point to continuing

consolidation in this area. Australian firms involved in this segment should evaluate their options carefully, and continue to monitor developments overseas to see how other firms are realigning their business strategies in response to slow growth.

Payment gateway providers will likely face growing pressure from the large US based operators, such as PayPal (eBay), Verisign and soon Google. This will put pressure on local operators and make independent sales of software difficult. Australian players in this market segment might consider exploring different payment options, as Bill Express has done with its pre-pay mobile technology. The increasing problem of online fraud must eventually cause changes to the conventional credit card based approach. To play in this area will require good relationships with banks and credit card firms, and it will be these organisations that drive the standards and the pace of change.

Because of the complexities involved, the supply chain segment in Australia is not progressing as rapidly as many would like. The situation appears to be similar in Europe, and even in the US it seems that outside the larger firms that have the funding, resources and commitment to undertake supply chain improvement properly, the successes have been moderate. It seems that implementing a successful enterprise wide supply chain project requires doing the 'hard yards', and may simply be beyond many firms. Australian firms working in this segment should select their target markets carefully.

Table 37. Australian trade & commerce software SWOT

Strengths	• A good concentration of software firms in the Payment Gateway space and the customs clearance space • A moderate concentration of firms in the e-commerce and supply chain spaces
Weaknesses	• Supply chain players and e-commerce platform players are facing slow growing market conditions. This is likely to make investment in Australian firms working in this space more difficult to obtain, thus restricting access to opportunities, and slowing down product development plans • Few linkages to sources of innovation is available to, or used by, these companies
Opportunities	• The initiatives being undertaken by the Australian Retailer Association and Bizdex offer the potential of creating business functionality templates across this sector, which could raise the standard of all Software products • Customs compliance and documentation market is fragmented at present with few entrenched competitors. Opportunities will be created for fast moving software firms with the increasing global focus on security and the World Customs Organization's strong push for standards harmonisation
Threats	• Complexity of integration is a major threat to adoption of supply chain technology and to a lesser extent, e-commerce platforms • The payment gateway market will come under increasing competition as large, household-name US firms aggressively promote their services • Supply chain and e-commerce platforms developers may find themselves outpaced in developments by foreign firms with greater stamina to ride out lean times • Initiatives like Bizdex may not succeed, and the lessons learned may be lost to the industry if not properly examined

Source: CIIER Analysis.

Despite these difficulties, initiatives being undertaken by the Australian Retailers Association (ARA) may point the way to improved opportunities for Australian software in the areas of e-procurement and the supply chain. The ARA's e-commerce committee is developing and documenting a set of standard business functions in the form of a functional template for point-of-sale (POS) vendors. The intention is to create more conformity and consistency between the various POS systems, as retailers will use the template to validate software prior to purchase. It is this lack of conformity in the way the different systems implement business processes, and the inability of end users to articulate in detail what they need, that has resulted in less efficient supply chains. By providing end users with templates to use during procurement, it will raise the standard of the software to the minimum base standard, and allow the software vendors to focus on value adding—thus creating a more competitive environment. The Bizdex initiative is somewhat similar in nature, but it is focused mainly on interoperability between businesses. The ARA project is looking more at interoperability problems within businesses. Both of these initiatives have merit, and will result in a more sophisticated and demanding user base, which will drive greater sophistication and quality in the

software base. It will be important to properly assess the progress of these initiatives and share the learning among the industry regardless of the outcomes.

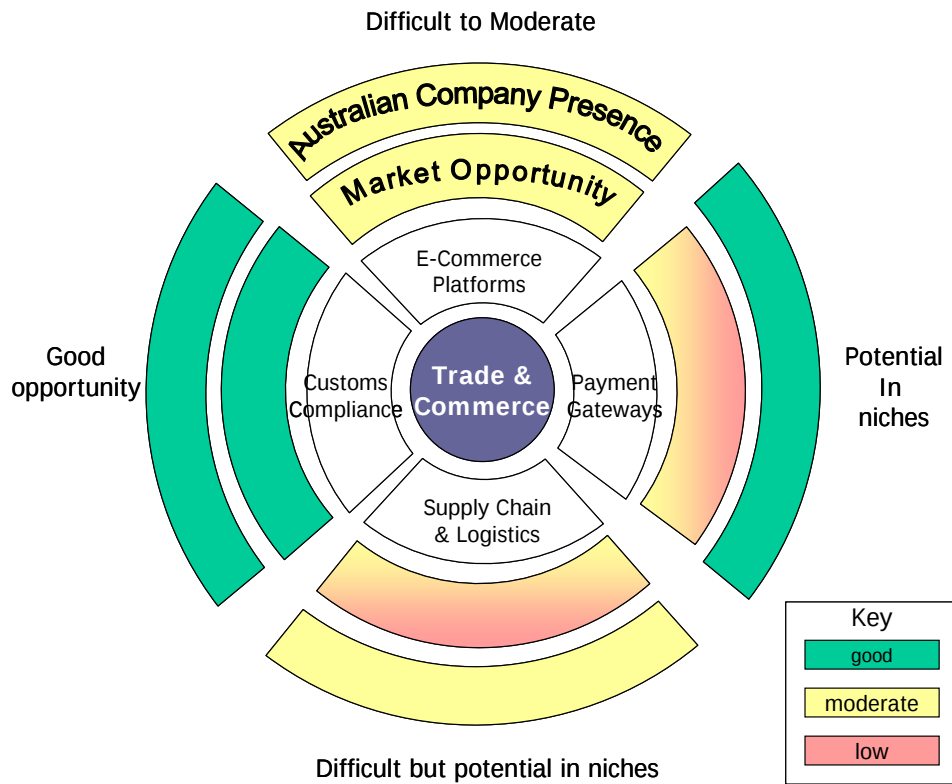


Figure 33. Overall opportunity for Australian firms

Source: CIER Analysis.

There are some interesting niche developments in the supply chain segment based around web hosted service offerings, although progress will most likely be slow given the cautious views being expressed about growth in the segment. The CSIRO's adaptive supply chain research offers interesting possibilities, but the apparent lack of involvement by Australian software developers raises concerns that the technology might be taken up by foreign MNCs first.

The customs compliance area is one where the opportunities may be greater for Australian firms. The recent changes in world customs regulations mean that there are opportunities and willing customers for state-of-the-art compliance software. The competition in this area appears fragmented. We would expect that a well developed platform, that can be easily integrated within a business's existing processes and internal systems, may enjoy good opportunities in many countries. Most Australian firms are small, however, and the difficulty lies in achieving the growth and scale necessary to compete offshore when starting from a small base.

Endnotes

- ¹ A comprehensive searchable database of government ICT policies can be found at <http://www.ictpolicy.edna.edu.au>. Information about Australia's National Software Evaluation Project can be found at <http://www.edna.edu.au/edna/page2492.html>.
- ² Australia's national gateway to education-related technical standards can be found at <http://standards.edna.edu.au/>.
- ³ See EdNA links at <http://www.edna.edu.au/> and the government education portal at <http://www.education.gov.au/>.
- ⁴ See, for example, NOIE (2002) *Broadband in Education: Availability, Initiatives and Issues*, DCITA, Canberra; and DEST (2004) *National Collaborative Research Infrastructure Strategy*, DEST, Canberra
http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/ncris/.
- ⁵ Huws, U. and O'Regan, S. (2001) *eWork in Europe: The EMERGENCE 18-Country Employer Survey*, Report 380, Institute for Employment Studies, Brighton, p46.
- ⁶ ABS (2002) *Education and Training Indicators: Australia 2002*, Cat No 4230.0, ABS, Canberra.
- ⁷ ABS (2002) *Education and Training Indicators: Australia 2002*, Cat No 4230.0, ABS, Canberra.
- ⁸ ABS (2002) *Education and Training Indicators: Australia 2002*, Cat No 4230.0, ABS, Canberra.
- ⁹ OECD (2001) *E-Learning: The Partnership Challenge*, OECD, Paris, p20.
- ¹⁰ DET (2002) 'Press Release,' 21 June 2002.
(https://www.det.nsw.edu.au/newsroom/yr2002/jun/new_computer.htm).
- ¹¹ SIBIS (2003) *Benchmarking education in the information society in Europe and the US*, SIBIS-WP4, March 2003.
- ¹² OECD (1998) *New Developments in Educational Software and Multimedia*, OECD, Paris, p3.
- ¹³ European Commission (2003) *The eLearning industry and market in Europe*, European Commission, March 2003).
- ¹⁴ InterfaceNOW.com (2004) *E-learning: Regional players take the next step*,
<http://www.interfacemediagroup.com/syndicatepro/displayarticle.asp?ArticleID=831>
- ¹⁵ MMV (2004) *Growing Victoria's e-learning industry*, Melbourne, p2.
- ¹⁶ EMarketer (2005) *E-Learning*, July 2005.
<http://banners.noticiasdot.com/termometro/boletines/docs/consultoras/emarketer/2003/07/emarketer-0703-elearning.pdf>
- ¹⁷ Monster Learning Asia Pacific survey, IDC, Frost and Sullivan.
- ¹⁸ DEST (2003) *Mapping Australian Science & Innovation*, Department of Education, Science & Training, Canberra, p303.
- ¹⁹ SIBIS (2003) *Benchmarking education in the information society in Europe and the US*, SIBIS-WP4, March 2003. Cited by EC (2003) *The eLearning industry and market in Europe*, European Commission, March 2003.
- ²⁰ Dudman, J. (2003) 'Vertical market focus: Stay in school,' *Computer Weekly*, 25 February 2003.

-
- ²¹ National Seminar, Education.au, 30 July 2004
(http://www.educationau.edu.au/ICT_seminar/300704.pdf).
 - ²² IDC (2005) IT Spending 2005.
 - ²³ Education.au estimate.
 - ²⁴ DET (2005) Annual Report 2004, Department of Education & Training, Sydney.
(https://www.det.nsw.edu.au/reports_stats/annual_reports/yr2004/contents.htm).
 - ²⁵ O'Neill, R. (2004) 'NSW Education to replace IT system,' Sydney Morning Herald, 30 November 2004.
 - ²⁶ DET (2005) 2005-06 Victorian Budget, Department of Education and Training, Melbourne.
(<http://www.det.vic.gov.au/det/resources/budget2005.htm>).
 - ²⁷ Minister for Education Services (2005) Press Release, 7 July 2005.
(http://www.dpc.vic.gov.au/domino/Web_Notes/newmedia.nsf/0/3dabe8c76079b27fca257037007c0285?OpenDocument)
 - ²⁸ A comprehensive list of ICT policies in education can be found at
<http://www.ictpolicy.edna.edu.au>.
 - ²⁹ Simba (2004) Global STM Market Analysis & Forecast 2003, Simba Information, Stamford CT.
Available http://www.simbanet.com/publications/report_gstm.htm accessed August 2004.
 - ³⁰ CAUL (www.caul.edu.au).
 - ³¹ UK Department of Education and Skills (2003) Towards a Unified e-Learning Strategy, HMSO, London, p7.
 - ³² UK Department of Education and Skills (2003) Towards a Unified e-Learning Strategy, HMSO, London, pp9-10.
 - ³³ Houghton, J.W., Steele, C. and Henty, M. (2003) Changing Research Practices in the Digital Information and Communication Environment, Department of Education, Science and Training, Canberra. (<http://eprints.anu.edu.au/archive/00002196/>).
 - ³⁴ National Science Board (2002) Science and Engineering Indicators 2002. National Science Foundation, Arlington, VA, 2002 (NSB-02-1), p8-24.
 - ³⁵ Sargent, M. (2002) A Framework for an Australian Research and Education Network, Department of Education, Science and Training, Canberra., p12.
 - ³⁶ Education for Change Ltd, SIRU University of Brighton and The Research Partnership (2002), Researchers' Use of Libraries and other Information Sources: current patterns and future trends, Research Support Libraries Group.
 - ³⁷ Friedlander, A. (2002), Dimensions and Use of the Scholarly Information Environment, Digital Library Federation and Council on Library and Information Resources, Washington D.C., November 2002.
 - ³⁸ Healy, L. W. (2002), The voice of the user: where students and faculty go for information, Paper presented at Educause 2000 Atlanta.
 - ³⁹ National Research Council (2001) Issues for Science and Engineering Researchers in the Digital Age, Office of Special Projects, Policy and Global Affairs, National Research Council, National Academy Press, Washington D.C. p5.
 - ⁴⁰ JISC Scholarly Communications Group (2002), Final report from the JISC Scholarly Communications Group (SCG) to the Research Support Libraries Group (RSLG), JISC.
 - ⁴¹ Houghton, J.W., Steele, C. and Henty, M. (2003) Changing Research Practices in the Digital Information and Communication Environment, Department of Education, Science and Training, Canberra. (<http://eprints.anu.edu.au/archive/00002196/>).

-
- ⁴² Houghton, J.W. (2005) *Digital Broadband Content: Scientific Publishing*, OECD, Paris, p3.
- ⁴³ Woodhead, B. (2005) 'SA school system to go up for tender,' *Australian Financial Review*, 24 June 2005, p66.
- ⁴⁴ Gray, P. (2003) 'In-depth: RMIT's Peoplesoft disaster,' *ZDNet Australia*, September 2003. <http://www.zdnet.com.au/news/business/0,39023166,20279146,00.htm>
- ⁴⁵ Cochrane, T. (2002) *The IT agenda at QUT: past, present and future*, QUT, Brisbane.
- ⁴⁶ McCandless, G. (2004) *Pricing and licensing educational software*, *Edu-Market E-Magazine*, April 2004.
- ⁴⁷ The stakeholders in the networked educational market include: traditional education providers (eg. schools, universities, libraries); funders (eg. governments, international organisations and private sector firms); publishers; broadcasters; telecommunication, cable and satellite services; software and technology providers; online information services; and individual learners. See OECD (1998) *New Developments in Educational Software and Multimedia*, OECD, Paris, p4.
- ⁴⁸ UK Department of Education and Skills (2003) *Towards a Unified e-Learning Strategy*, HMSO, London, p36.
- ⁴⁹ OECD (2001) *Learning to Change: ICT in Schools*, OECD, Paris, p47.
- ⁵⁰ Becta (2001) *Becta Corporate Plan 2001-2004*, Becta, Coventry, p12.
- ⁵¹ JISC (2001) *JISC Five-Year Strategy 2001-2005*, JISC.
- ⁵² Abram, S. (2003) 'A primer on e-learning: The framework, the market and the players,' *KMWorld* 12(2), February 2003.
- ⁵³ See www.schoolforge.net and www.osef.org.
- ⁵⁴ In January 2004, the OECD Committee for Scientific and Technological Policy at Ministerial level issued a statement saying that: Ministers recognised that fostering broader, open access to and wide use of research data would enhance the quality and productivity of science systems worldwide. They adopted a Declaration on Access to Digital Research Data from Public Funding (http://www.oecd.org/document/0,2340,en_2649_34487_25998799_1_1_1_1,00.html).
- ⁵⁵ In mid 2003, the Bethesda Statement on Open Access Publishing emerged from meetings of relevant parties – including the organisations that foster and support scientific research, the scientists that generate the research results, the publishers who facilitate the peer-review and distribution of the results of research, and the scientists, librarians and others who depend upon access to this knowledge. It endorsed the principles of open access and sought to promote the rapid and efficient transition to open access publishing (<http://www.earlham.edu/~peters/fos/bethesda.htm>). In October 2003, Germany's Max Planck Society, France's Centre National de la Recherche Scientifique, and other major European research institutes and funders endorsed open access in the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, by: encouraging researchers/grant recipients to publish their work according to the principles of the open access paradigm; encouraging the holders of cultural heritage to support open access by providing their resources on the Internet; developing means and ways to evaluate open access contributions and online-journals in order to maintain the standards of quality assurance and good scientific practice; advocating that open access publication be recognised in promotion and tenure evaluation; and advocating the intrinsic merit of contributions to an open access infrastructure by software tool development, content provision, metadata creation, or the publication of individual articles. (<http://www.zim.mpg.de/openaccess-berlin/berlindeclaration.html>).
- ⁵⁶ See OECD (2005) *Digital Broadband Content: Scientific Publishing*, OECD, Paris.

-
- ⁵⁷ Becta (2005) Open Source Software in Schools: A study of the spectrum of use and related ICT infrastructure costs, Becta (www.becta.org.uk/corporate/press_out.cfm?id=4681). See also, Moyle, K. (2003) Open Source Software and Australian School Education, education.au (www.educationau.edu.au/papers/open_source.doc).
- ⁵⁸ OECD (2005) E-learning in Tertiary Education; Where do we stand?, OECD Paris, p16.
- ⁵⁹ Australian Financial Review, 19 July 2005, p26.
- ⁶⁰ <http://www.proteomesystems.com>
- ⁶¹ <http://www.dstc.com/>
- ⁶² Sargent, M.A. et al. (2005) An e-Research Strategic Framework, Department of Education, Science and Training, Canberra, pp9-10. See also DEST (2003) Mapping Australian Science & Innovation, Department of Education, Science & Training, Canberra, p304.
- ⁶³ <http://www.dest.gov.au/e-research/>
- ⁶⁴ Sargent, M.A. et al. (2005) An e-Research Strategic Framework, Department of Education, Science and Training, Canberra, p14
- ⁶⁵ Compiled from CRC websites.
- ⁶⁶ Austrade (2002) Australian eLearning, Austrade, Canberra.
- ⁶⁷ White G. (2004) 'E-learning: Australia's achievements in education and training,' education. http://www.educationau.edu.au/papers/CeBIT_gw.pdf
- ⁶⁸ European Commission (2003) The eLearning industry and market in Europe, European Commission, March 2003.
- ⁶⁹ MMV (2004) Growing Victoria's e-learning industry, Melbourne, p7.
- ⁷⁰ <http://www.harvestroad.com/>
- ⁷¹ <http://www.inchain.com.au/>
- ⁷² MMV (2004) Growing Victoria's e-learning industry, Melbourne, p7.
- ⁷³ <http://www.thelearningedge.com.au>
- ⁷⁴ <http://www.mmv.vic.gov.au>
- ⁷⁵ <http://www.ziptales.com.au/>
- ⁷⁶ <http://www.celeradiscoverysystem.com>
- ⁷⁷ <http://www.proteomesystems.com>
- ⁷⁸ <http://www.csa.com/>
- ⁷⁹ <http://www.ebsco.com>
- ⁸⁰ <http://www.iii.com/>
- ⁸¹ <http://www.ovid.com>
- ⁸² <http://www.il.proquest.com>
- ⁸³ See <http://www.melcoe.mq.edu>.
- ⁸⁴ Education.au (2005) Education.au limited capability statement, Adelaide. (http://www.educationau.edu.au/about/capability_statement.pdf).
- ⁸⁵ Global e-government readiness report 2004 - Towards access for opportunity: United Nations.
- ⁸⁶ High Performance in e-Government: Accenture 2004.
- ⁸⁷ High Performance in e-Government: Accenture 2004.
- ⁸⁸ Better Services, Better Government; November 2002, NOIE
- ⁸⁹ Government Spending on IT – Phillip Allen, Feb 2004, IDC published by Microsoft

-
- ⁹⁰ OIT Corporate Plan 2002-2005: NSW Chief Information Office
- ⁹¹ Scrutiny of Acts and Regulations Committee Victorian Electronic Democracy, Final Report, May 2005
- ⁹² Victorian government audit office.
- ⁹³ Ibid.
- ⁹⁴ e-Government Strategy for the Western Australian Public Sector: Government of Western Australia, 2004.
- ⁹⁵ Smart Directions Statement Queensland the Smart State for Information and Communications Technology within the Queensland Government – Dec 2004.
- ⁹⁶ DCITA: www.dcita.gov.au
- ⁹⁷ Tigers Report Program Summary June 2003: Croger Associates et. al.
- ⁹⁸ IDC cited in Asia Pacific governments increase technology spending : tcdtrade.com
- ⁹⁹ Peoples Daily July 2002.
- ¹⁰⁰ China Daily February 12, 2003.
- ¹⁰¹ Singapore Ministry of Information Communications and the Arts.
- ¹⁰² Infocomm Development Authority of Singapore.
- ¹⁰³ High Performance in e-Government: Accenture 2004.
- ¹⁰⁴ e-Government Strategy: Simplified Delivery of Services to Citizens – Office of Budget and Management 2002.
- ¹⁰⁵ Input: Jan 2005.
- ¹⁰⁶ Ibid.
- ¹⁰⁷ State & Local Market Analysis: E-Government MarketView: Input 2004
- ¹⁰⁸ High Performance in e-Government: Accenture 2004.
- ¹⁰⁹ Deutsche Welle – August 2004 (www.dw-world.de).
- ¹¹⁰ European Commission: IADBC (europa.eu.int/idabc/en/home).
- ¹¹¹ High Performance in e-Government: Accenture 2004.
- ¹¹² French Ministry of the Economy, Finance and Industry announcement April 2003.
- ¹¹³ High Performance in e-Government: Accenture 2004.
- ¹¹⁴ CIO magazine – November 2004 (www.cio.com.au).
- ¹¹⁵ High Performance in e-Government: Accenture 2004.
- ¹¹⁶ Ibid.
- ¹¹⁷ European Commission: IADBC (europa.eu.int/idabc/en/home).
- ¹¹⁸ High Performance in e-Government: Accenture 2004.
- ¹¹⁹ Oracle And Microsoft Gain In Database Market: Information Week ; March 14 2005.
- ¹²⁰ Oh, the 'maturing' middleware market: The Register 26th July 2005.
- ¹²¹ Application servers fuel e-gov: Washington Technology: 21st July 2003.
- ¹²² Forbes.com May 2005.
- ¹²³ U.S. Market Is Emerging as Leader for Secure Applications Using Contactless Smart Card Technology: www.smartcardalliance.org: June 2005.
- ¹²⁴ American Passports to Get Chipped: Wired.com ; Oct 2004.

-
- ¹²⁵ Oracle and Intel join forces for RFID push: vnunet.com ; April 2005.
- ¹²⁶ www.egov.vic.gov.au
- ¹²⁷ Hong Kong rolling out ID cards based on Keycorp smartcard technology: July 2004 : Press Release Keycorp
- ¹²⁸ Protocon.com.au: Company facts.
- ¹²⁹ Information Services Corporation Saskatchewan www.isc.ca.
- ¹³⁰ FinMap International.
- ¹³¹ Daratech 2004 GIS Markets and Opportunities Report as cited in Directions Magazine.
- ¹³² High Performance in e-Government: Accenture 2004.
- ¹³³ Jonathan Gamlen, Software AG 2003.
- ¹³⁴ The Institute for Supply Management Dec 2004: as cited by Institute for eGovt competence centre Germany
- ¹³⁵ Software on Demand: IT Enquirer 3rd August 2005.
- ¹³⁶ METAspectrum.
- ¹³⁷ Metagroup.
- ¹³⁸ A Guide to Queensland E-Security Industry: Queensland Government Department of Innovation and Information Economy.
- ¹³⁹ CRCSI current Projects: July 05.
- ¹⁴⁰ Web Services Security : May 2003: Christine O'Keefe : Security & Privacy Group
CSIRO Mathematical & Information Sciences
- ¹⁴¹ In process manufacturing, the product is produced in a continuous stream. Refining oil, bottling beer, and rolling steel are examples. Assembly lines are a form of process manufacturing if the products are identical; if the products are customised the boundary between discrete and process manufacturing blurs.
- ¹⁴² AMR Research annual report on the state of the ERP market, released June 2005.
- ¹⁴³ For example, in Asia, globalisation and market liberalisation is causing the region's chemical/ petrochemical companies to experience competitive pressures from further afield. This is driving them to use ERPs to develop a competitive advantage; but it is how the ICT solutions are implemented that will be critical to success. Source: IDC report 'Petrochemical/Chemical Manufacturing: Case Studies and Best Practices in IT Deployment '. May 2005.
- ¹⁴⁴ Digital Planet 2004 – The Global Information Economy, WITSA/Global Insight Inc. (Press Release 23 November 2004 by WITSA - www.witsa.org/press/11-22-04DP-US_5.pdf; Executive Summary - www.witsa.org/digitalplanet/DP2004-Summary.pdf).
- ¹⁴⁵ IDC data (2004 and 2005), pro-rated for 2003.
- ¹⁴⁶ Ibid. Reported April 2004 at www.e-austenite.co.uk/offshore_outsource.htm and elsewhere.
- ¹⁴⁷ Cheshire Henbury (consultancy specialising in long term strategic issues in manufacturing industry). Website, accessed 06-Jun-05.
- ¹⁴⁸ In June 2005, Oracle launched a campaign directly targeting SAP clients. Under Oracle Fusion for SAP or 'OFF SAP', Oracle will offer SAP R/3 customers up to a 100% license credit, to switch from SAP to Oracle applications. Source: www.beerfiles.com.au/content/view/1463/1/
- ¹⁴⁹ Supply Chain Management seeks to achieve many benefits from integrating the supply chain, including: 25–50% reduction in total supply chain costs, 25–60% reduction in inventory-holding, 25–80% increase in forecast accuracy, and 30–50% improvement in order-fulfilment cycle time.

-
- Source: Pittiglio Rabin Todd & McGrath ('PRTM'), specialists in supply chain and operations. (www.prtm.com/services/one.asp?service_id=1, accessed June 2005).
- ¹⁵⁰ Enterprises use Product Lifecycle Management (PLM) solutions to help track and share product and design/manufacturing process data, inside and outside the enterprise, throughout the product definition lifecycle. That is, from concept to design, during manufacturing, through maintenance, and with supply chain partners.
- ¹⁵¹ Source: www.uk.capgemini.com/industry/manufacturing_industry/about.shtml
- ¹⁵² For example, power generation authorities are anxious to work with manufacturers of domestic refrigerators to reduce peak power consumption (through controlling units via the Internet) and avoid the need for expensive infrastructure upgrades. Similarly, some dwellers in high-density city areas are choosing an adaptation of the car-hire model as an alternative to actually owning a vehicle.
- ¹⁵³ Source: Foresighting Group report, p49. See also, McKinsey report, p9.
- ¹⁵⁴ 'Insight ' report, April 2005 (document #33194).
- ¹⁵⁵ p9 and pp12-13.
- ¹⁵⁶ Source: 'Important Manufacturing Issues ' per 'Manufacturing Insights ' 08-Jun-05 (IDC – www.manufacturing-insights.com).
- ¹⁵⁷ See also, Manufacturing Insights (an IDC company), whose website reported of RFID 'The spotlight is beginning to fade as the performance of the technology is disappointing and the lack of a clear business case has investment by [those who are mandated to use RFID] to a minimum. (Website www.manufacturing-insights.com – accessed 08-Jun-05).
- ¹⁵⁸ The Gartner Group has declared SaaS as one of the top five technologies for 2005 and IDC predicts that by 2008 subscription license revenues will hit \$43 billion. (Source: www.aspnews.com/trends/article.php/3492541).
- ¹⁵⁹ McKinsey & Co.
- ¹⁶⁰ Measuring Success: Identifying Performance Indicators, Celemi Publishing Inc., 2000.
- ¹⁶¹ RES Software – www.remansoftware.com
- ¹⁶² An expert system captures the implicit knowledge and thought processes of experienced employees (or other experts), making them accessible to others.
- ¹⁶³ MMI - Man-Machine Interface (sometimes HMI - Human-Machine Interface); SCADA - Supervisory Control and Data Acquisition.
- ¹⁶⁴ PACs combine the functionality of a PC and reliability of a PLC (programmable logic controller). PACs can be used to develop custom control and monitoring systems for data acquisition, motion control and image acquisition for wide-ranging applications.
- ¹⁶⁵ Systems that capture the implicit knowledge and thought processes of experienced employees, making them accessible to others.
- ¹⁶⁶ Australian Firm QX Corporation has invented a position-finding system akin to GPS but with improved precision and without the need for satellites and hence significantly lower cost. Applications exist in heavy industry, ports & airports, warehousing and elsewhere. BlueScope Steel has conducted trials.
- ¹⁶⁷ <http://www.crcimst.com.au/>
- ¹⁶⁸ <http://www.crcws.com.au/>
- ¹⁶⁹ A helpful introduction to Business Process Management, titled 'The BP Trends 2005 BPM Suites Report ' is available from www.bptrends.com

-
- ¹⁷⁰ Source: Gartner Forecasts - ERP Software, Worldwide: (i) 2003-2008, 3Q04 Update (5 January 2005) and (ii) 2004-2009, Preliminary Executive Summary (6 May 2005), and as quoted at www.acsicorp.com/services_practices_apl_impl.php.
- ¹⁷¹ In the Australia / New Zealand market, Cogita considers there are at least five thousand firms in the make-to-order engineering and manufacturing niche in which the firm specialises. Cogita (www.cogita.com) is a specialist services firm supplying independent systems support throughout Australia and New Zealand for blue chip clients who use manufacturing resource planning (MRPII) and enterprise resource planning (ERP) systems.
- ¹⁷² For example, ERP penetration in India is reported to have reached 37% in 2003 (Source: Nasscom Newline - www.nasscom.org/newline/nove03/feature.asp).
- ¹⁷³ Gartner Dataquest, reported by Nasscom Newline - www.nasscom.org/newline/nove03/feature.asp
- ¹⁷⁴ McKinsey's report (page 96).
- ¹⁷⁵ 'Leverage (influence) in the enterprise is moving up the stack and closer to the business process. ' (IDC – reported in Computer Weekly, Dec 2004, commenting on IDC's predictions for 2005.
- ¹⁷⁶ 'Organisational barriers to IT adoption are waning, favouring Vertical players. There are signs that a new generation of IT-literate executives is being recruited into top positions—for example, [the US grocery chain] Albertson has recruited an ex-GE executive with IT credentials ' . McKinsey's report, p91.
- ¹⁷⁷ See the McKinsey report, p83, which states: 'The main uncertainty centres on the evolution of Web Services standards. One of the major challenges today for businesses is the integration of horizontal software applications. It is often a costly and complex process to integrate new applications with existing applications—for example, ensuring a Siebel SCM application links to an existing SAP ERP application—as well as with business processes—for example, linking the SCM applications of disparate business units. '
- ¹⁷⁸ 'Dynamic IT 'is an IDC term, referring to flexible, scalable and powerful infrastructures that are inherently vendor, OS and architecture neutral.
- ¹⁷⁹ In relation to SCADA, the Australian Sugar industry may be a useful focus. Australia produces approximately 4% of the world's sugar supply, and exports approximately 12% of the sugar traded worldwide (most producing countries export little). Brazil accounts for 24% of worldwide sugar trade. Production in Africa, Thailand, Pakistan and India is increasing. Australia has active research programs in relation to sugar production.
Source: www.nuca.ie.ufrj.br/infosucro/biblioteca/mercadomundial/the_sugar_industry.pdf
- ¹⁸⁰ www.austrade.gov.au in the 'Industry and Country Information 'section, under the heading 'IT Industry Profiles'. (Accessed on 09-Jun-05.) Some data is from Austrade's counterparts in other countries.
- ¹⁸¹ Melbourne software developer Mid-Comp International Pty Ltd has recently achieved success in the US with warehousing and distribution software.
- ¹⁸² Source: US Commercial Services www.buyusainfo.net
- ¹⁸³ McKinsey report, p16.
- ¹⁸⁴ Australian Bureau of Statistics: Year Book Australia 2003, Industry Overview – Output and employment by industry, 2003.
- ¹⁸⁵ 'Peak Oil ', Colin Campbell, 1999.
- ¹⁸⁶ MBendi Information Services 2005.
- ¹⁸⁷ ABARE, Austrade.

-
- ¹⁸⁸ Woodhead, B. & Connors, E. (2005) 'China boom fuels surge in IT spending,' Australian Financial Review, 19 July 2005, p1.
- ¹⁸⁹ ABARE 2004 mining report.
- ¹⁹⁰ ABARE 2002 mining report
- ¹⁹¹ Austrade website, Country reference. Peru.
- ¹⁹² 'ICT and the Australian Mining Industry ', OVUM, 2003.
- ¹⁹³ MBendi Information Services 2005.
- ¹⁹⁴ Computerworld, 10 June 2005.
- ¹⁹⁵ Australian Bureau of Agriculture and Resource Economics (ABARE) 2005.
- ¹⁹⁶ Whitehorse Top 250, ABARE.
- ¹⁹⁷ CIIER/Whitehorse research on IT Services sector, 1998-2005 ICT Top 250 analysis.
- ¹⁹⁸ Ovum (2003) ICT and the Australian Mining Industry, A Report to NOIE and DCITA, Canberra.
- ¹⁹⁹ Ovum (2003) ICT and the Australian Mining Industry, A Report to NOIE and DCITA, Canberra.
- ²⁰⁰ Ovum (2003) ICT and the Australian Mining Industry, A Report to NOIE and DCITA, Canberra.
- ²⁰¹ Annual Report 2003-4, CRC for Predictive Mineral Discovery.
- ²⁰² US Census Bureau Quarterly Retail E-Commerce Sales 2000-2005
- ²⁰³ E-Commerce – A Perfect Market: The Economist May 2004.
- ²⁰⁴ US Census Bureau.
- ²⁰⁵ US Census Bureau.
- ²⁰⁶ The European E-Business Report: 2004 – e Business Watch – European Commission.
- ²⁰⁷ Newsletters - Innovation and Technology Update - Bulletin No. 6, June 2002: ABS.
- ²⁰⁸ ROI on supply-chain software has been a long time coming, but it's now in sight: Information Week Feb 2003.
- ²⁰⁹ The AMR Research Supply Chain and the new Trillion Dollar Opportunity: Nov 2004.
- ²¹⁰ Department of Communications Information Technology and the Arts (DCTIA).
- ²¹¹ Optimising of the wheat industry supply chain ITOL project: March 2005: Standards Australia.
- ²¹² End User eBusiness and Interoperability Workshop – Feb 2005: Standards Australia.
- ²¹³ Optimising of the wheat industry supply chain ITOL project: March 2005: Standards Australia
- ²¹⁴ The European E-Business Report: 2004 – e Business Watch – European Commission.
- ²¹⁵ Julian Josem - E-Commerce Consultant – Australian Retailers Association.
- ²¹⁶ 4W RFID readers given go-ahead: 13 July 2005 : Supply Chain Review
- ²¹⁷ From Visibility to Action – Trends and Issues in Logistics and Transportation – 2004: Oracle; GapGemini; Georgia Southern University (Abbot, Mandrot, Moore).
- ²¹⁸ From Visibility to Action – Trends and Issues in Logistics and Transportation – 2004: Oracle; GapGemini; Georgia Southern University (Abbot, Mandrot, Moore).
- ²¹⁹ Lack of collaboration reducing supply chain benefits : Justin Greig, director, Capgemini 9 March 2005.
- ²²⁰ Lack of collaboration reducing supply chain benefits : Justin Greig, director, Capgemini 9 March 2005.
- ²²¹ Julian Josem - E-Commerce Consultant – Australian Retailers Association.
- ²²² EAN Australia June 2004.

-
- ²²³ Cargo system scores trifecta for legislative delays: Computerworld 6th July 2005.
 - ²²⁴ Forrester Research November 2004.
 - ²²⁵ The sweet taste of e-commerce success: The Age 7th Dec 2004.
 - ²²⁶ Why Government Isn't Buying E-procurement : CIO Magazine 5th Oct 2004.
 - ²²⁷ Glen Nicholson, manager of e-government e-business projects with AGIMO. Cited in CIO magazine, Oct 2004.
 - ²²⁸ The European E-Business Report 2004: European Commission – e-Business Watch.
 - ²²⁹ Frost and Sullivan 2004.
 - ²³⁰ CommSecure Limited 2004 Appendix 4D Half-Year Report.
 - ²³¹ Paymentsnews.com
 - ²³² Wall Street Journal Online June 18 2005.
 - ²³³ Prepaid Insights 2005 – 2009 – Atlantic ACM.
 - ²³⁴ Pago eTransaction Services GmbH – June 2005.
 - ²³⁵ Infoworld 2003.
 - ²³⁶ ARC Research - Supply Chain Management Worldwide Outlook 2003.
 - ²³⁷ Phillip Allen - IDC 2003.
 - ²³⁸ Marketstrat Inc – April 2005
 - ²³⁹ RFID in Manufacturing: The race to radio-tag is heating up in manufacturing: Datamonitor May 2005.
 - ²⁴⁰ www.pangaeaworld.com/
 - ²⁴¹ www.cbfca.com.au
 - ²⁴² www.customs.gov.au
 - ²⁴³ Supply Chain Software Provider, Kewill Systems: Investor Chronical : Jan 2004.
 - ²⁴⁴ www.cmis.csiro.au
 - ²⁴⁵ Applying innovative decision support technologies to achieve harmony and adaptability in an Australian wine supply network: Dunstal; Johnston : SMART 2005 Conference June 2005

**Centre for Innovative Industry Economic
Research Consortium**

**The Australian software industry and
vertical applications markets:
Globally competitive and
domestically undervalued**

**Part C
Vertical markets 6–8,
Export analysis**

Table of contents—Part C Vertical markets 6–8; Export analysis

Energy	268
The energy software product system.....	268
Energy markets.....	270
The energy software market	277
The customer base for energy software	278
Energy software suppliers.....	286
Innovation base and support infrastructure	287
Energy market conclusions.....	288
Health.....	291
The health software product system.....	291
E-health markets.....	293
The e-health software market	305
E-health software suppliers.....	315
Innovation base and support infrastructure	316
Health market conclusions.....	318
Information and communications technology	322
The ICT software product system	322
Software markets	324
Australian ICT software suppliers	327
Innovation base and support infrastructure	337
ICT market conclusions	338
Export market opportunities	341
Export market conclusions.....	346
Endnotes	350

Figures

Figure 1.	The energy software product system.....	269
Figure 2.	Final energy consumption in Australia by type, 2001-02 to 2019-20	272
Figure 3.	Australia's regulatory structure	273
Figure 4.	Predicted growth rates in final energy consumption to 2020	277
Figure 5.	Energy vertical software market map	287
Figure 6.	Potential for Australian software firms within the energy market segment	290
Figure 7.	The health software product system.....	292
Figure 8.	Relationship between software segments and e-health drivers	295
Figure 9.	Australian Health expenditure.....	296
Figure 10.	Relationship between government bodies and health IT projects	297
Figure 11.	E-health vertical software market map	316
Figure 12.	Potential for Australian software in the e-health market.....	320
Figure 13.	Asia-Pacific software spending, 2002-07	325
Figure 14.	ICT vertical software market map	330
Figure 15.	Vertical software market analysis: Education.....	342
Figure 16.	Vertical software market analysis: Energy	342
Figure 17.	Vertical software market analysis: Government	343
Figure 18.	Vertical software market analysis: Health	343
Figure 19.	Vertical software market analysis: ICT.....	344
Figure 20.	Vertical software market analysis: Manufacturing	344
Figure 21.	Vertical software market analysis: Minerals.....	345
Figure 22.	Vertical software market analysis: Trade & Commerce	345
Figure 23.	Summary of export markets for selected verticals	347
Figure 24.	Detailed summary of vertical software markets	348

Tables

Table 1.	Australian Electricity Generation Market Share and Ownership.....	274
Table 2.	Australian Energy (Electricity and Gas) Retail Market Share	274
Table 3.	Australian firms in the RTAC market segment	280
Table 4.	Australian firms in the GFAS market segment.....	281
Table 5.	Australian firms in the EAM market segment	282
Table 6.	Australian firms in the T&RMS market segment	283
Table 7.	Australian firms in the CIS market segment.....	284
Table 8.	Australian firms in the energy efficiency market segment	285
Table 9.	Australian firms in the OES market segment	286
Table 10.	Overall SWOT analysis of Australian energy software firms	289
Table 11.	Health market indicators for selected countries- 2002?.....	299
Table 12.	Australian firms in the clinical systems market segment.....	306
Table 13.	Australian firms in the clinical support market segment	308
Table 14.	Australian firms in the medical devices market segment	310

Table 15.	Australian firms in the patient administration market segment	312
Table 16.	Australian firms in the finance, supply and admin market segment	313
Table 17.	Australian firms in the infrastructure market segment.....	315
Table 18.	Overall SWOT analysis for Australian health IT firms	319
Table 20.	Some ICT vertical market firms and products.....	332

Boxes

Box 1.	True Life Anatomy.....	307
Box 2.	Repatriation General Hospital.....	309
Box 3.	Cochlear Limited.....	311
Box 4.	Diagnostics CRC.....	317

Energy

The market for IT and software within the energy industry can be divided into two very broad groups that correspond with two facets of the industry itself. First, the energy supply side—energy utilities, energy supply and energy distribution. Second, the energy demand side—technologies that are concerned with monitoring and ensuring greater efficiency of energy use. These two broad groups themselves can be divided into a number of subsegments.

The utilities market (supply side) includes:

- real time automation and controls (RTAC)—systems for monitoring and controlling generation, transmission, distribution, and other utilities' infrastructure;
- geospatial and field automation solutions (GFAS)—systems for mapping, facilities management, outage management, and workforce management;
- enterprise asset management (EAM) systems—systems that manage the lifecycle, repair and maintenance of expensive infrastructure;
- billing and customer information systems (BCIS)—systems that manage the interaction with customers; and
- trading and risk management systems (T&RMS)—systems for trading in energy prices and such activities as emission credits trading and assessing probabilities and risks that have an impact on financial exposure.

The energy efficiency (demand side) includes:

- energy efficiency in the built environment—systems used to design, monitor or assess energy consumption in buildings;
- operational efficiency—systems to monitor and optimise or improve energy consumption in industrial processes; and
- demand management—systems to monitor and control energy demand.

The energy software product system

There is considerable change in the energy sector giving rise to new ICT-related opportunities. As a result, the energy product system dynamics are also in flux.

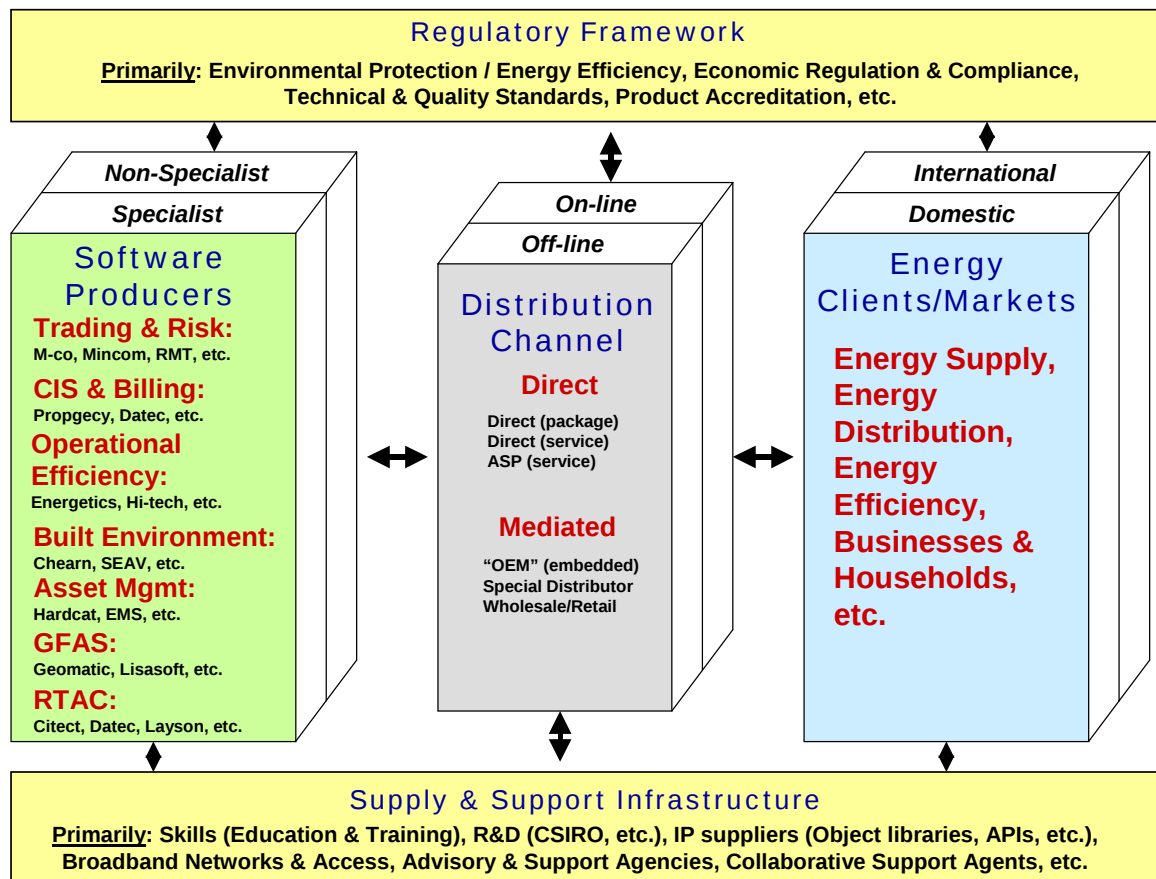
Regulatory developments are driving much of the change (e.g. emissions, energy efficiency etc.); those in the supply and distribution sector are responding to demands for greater operational efficiency (e.g. a change of emphasis toward technologies that reduce operating risk or support emission reduction).

Key relationships are between the energy sector and regulators, with software suppliers developing solutions to meet the needs of the sector to respond to new energy and regulatory demands. For software developers, collaboration with clients

and a deep understanding of the energy sector are essential, because the channel to markets in many cases is mediated through large suppliers of energy technology – almost all of these being foreign owned MNCs. Relationships between developers and regulators are required to ensure that software meets required standards and employs standard interfaces to support interoperability, as clients are seeking to move away from end-to-end solutions, towards integrated components supported by middleware.

There are also some important local innovation linkages between the R&D infrastructure, developers and their clients (e.g. CSIRO's Energy Transformed program). Building on such linkages, partnering and commercialisation could offer additional opportunities.

Figure 1. The energy software product system



Source: CSSES Analysis.

Software distribution (the channel) tends to be mediated. One important feature of the energy market is the role of equipment manufacturers (e.g. transformers, switches, metering), with some aspects of the vertical software market distribution mediated by equipment manufacturers (e.g. OEM/embedded).

For local developers in such areas, the limited extent of local ownership and control in the electronic and electrical equipment manufacturing industry presents a challenge, and will make the building of channel partnerships with large foreign owned manufacturers and MNCs increasingly important.

There is recognition of the need for interoperability in the industry, although there is a plethora of bodies conducting this work, including the International Standards Organization (ISO), which has convened a group to define industrial automation systems integration called ISO/TC-184.

There also exist proprietary based consortia like the OPC Foundation, which is defining a set of protocols and standards for industrial automation suppliers based on the Microsoft COM/DCOM component model.¹ In the metering space there are several competing standards, such as IEEE SCC31 and ANSI C12.

The Australian data interchange standard for electrical metering (AS 1284.10.1-1996) itself incorporates proprietary technology. It will be important for software developers to take account of, and work within these standards and standards blocs.

Energy markets

The world energy sector is undergoing a transition. Rapid change, especially in the electricity segment, is being caused by privatisation, market de-regulation, under-investment leading to under-capacity, and greenhouse gas emission reduction requirements. This has resulted in significant upheaval in the sector in many countries, including Australia.

One past president and CEO of the US based Electric Power Research Institute noted that:

We face the twenty-first century's burgeoning needs for energy armed with technologies that are fast becoming outmoded. The coming decades will place radically different and more challenging demands on the electricity system than can be met with today's technology and current investments in the electricity infrastructure.²

In their 2005 survey of global energy firms and investors, PriceWaterhouseCoopers noted the need for investment to meet growing world demand, saying:

Investment averaging USD 355 billion pa is needed by the power generation, transmission and distribution sector to meet the world's expected supply needs in the period to 2030. The cumulative investment adds up to almost USD 10 trillion, or 62%, of total energy investment over the period 2003 to 2030.³

However, investors are reluctant because of the perceived uncertainties in the regulatory environment:

This massive amount of capital will require utility firms to make a compelling case for investment. Yet many firms claim that they find themselves caught in a trap. They are striving to make their sector attractive to investors while grappling with regulatory uncertainty and market volatility that creates an investment hurdle.⁴

Australia's energy market

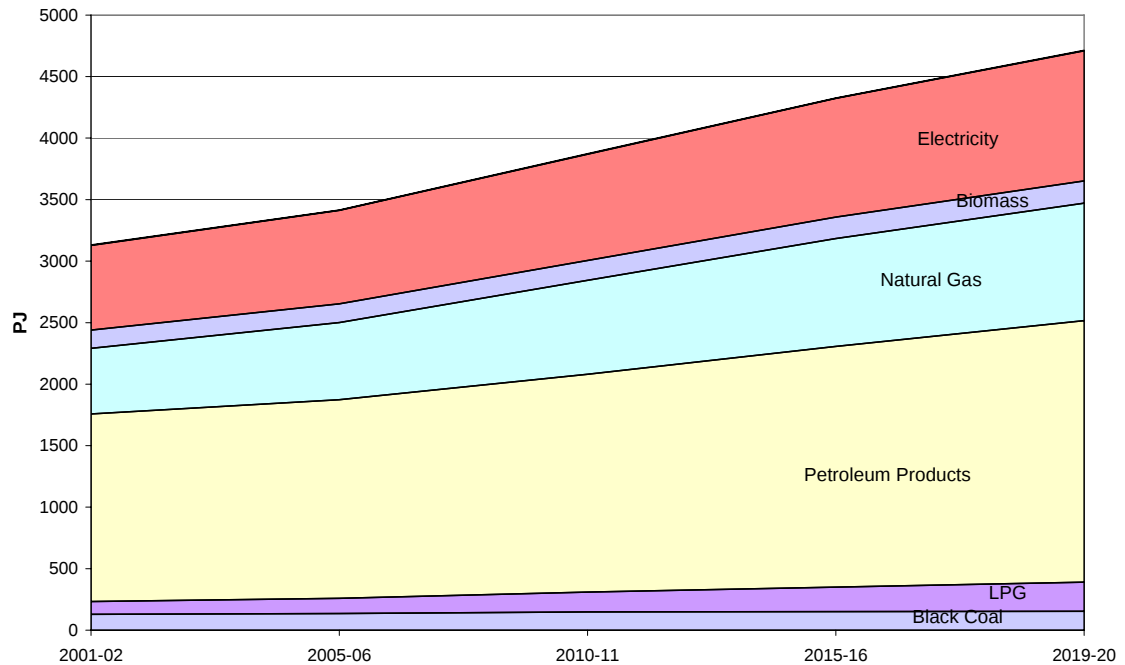
Australia's energy market is predicted to grow at a moderate rate, with final energy consumption to grow at 2% pa from 2000 to 2020—electricity consumption growing by 2.1% pa and gas consumption to grow at 2.9% pa.⁵ There is evidence that demand may be approaching supply capacity in some situations, with the New South Wales Department of Primary Industries reporting that while there is an over supply of base load capacity there are indications that during peak periods electricity demand can approach generating capacity.⁶

In Queensland the 2004 Somerville report concluded both Energex and Ergon Energy were over utilising their assets which resulted in a greater risk of supply failure,⁷ which has resulted in greater network investment in that state.

The South Australian Electricity Supply Industry Planning Council noted in its annual planning report that there is ample capacity to meet the peak demand expected in an average summer, but in an extreme—one in ten year summer the reserve capacity margin is below the accepted standard.⁸ It also provides a cautionary note on investment:

Given the projected tightening of the overall supply–demand balance across the entire national electricity market, the Planning Council is concerned that investment signals for new capacity may not be strong enough to ensure that investment keeps pace with the market's reliability targets.⁹

Figure 2. Forecast final energy consumption in Australia by type, 2001–02 to 2019–20



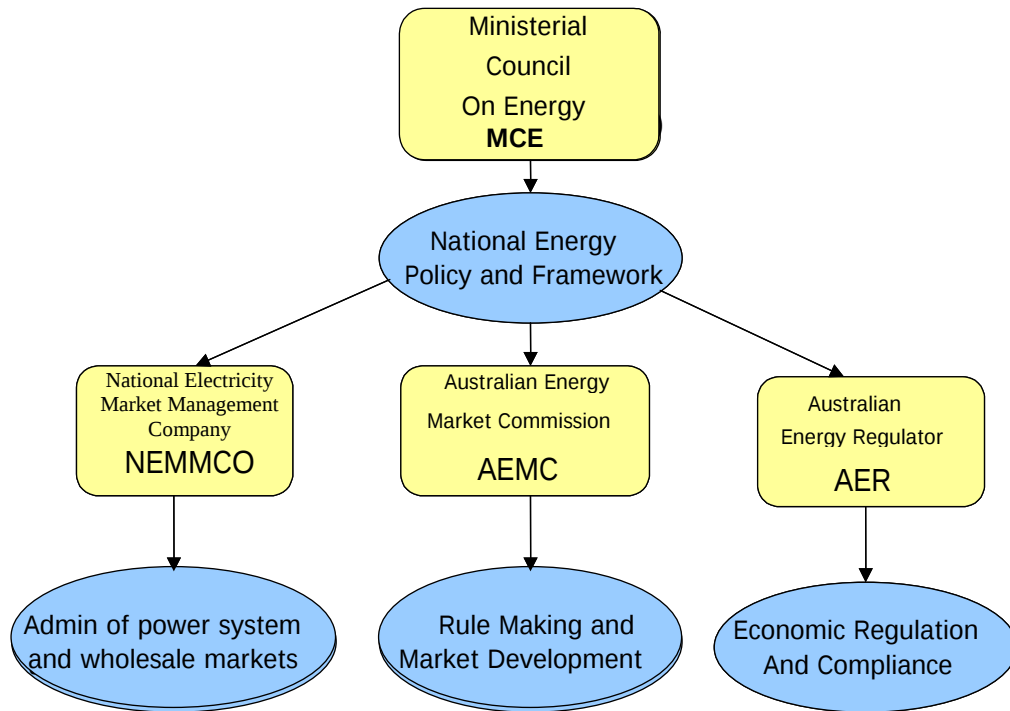
Source: ABARE 2004.

Energy supply (utilities)

In the past in Australia there have been criticisms that the desire of utilities to take risks and innovate was impaired by aspects of the market's operation,¹⁰ and investments in essential infrastructure needed to take advantage of energy reserves.¹¹

Over the last decade there has been significant effort to improve the operation of the sector. In response to the calls for a consistent regulatory framework, the Ministerial Council on Energy commenced a series of reforms in 2003, including forging intergovernmental agreements, establishing two new governance bodies and frameworks for distribution and retailing. In March 2005, the state premiers announced that they would be establishing a carbon emission trading scheme – a major change for the industry, and a potential opportunity for software developers as such an initiative is likely to involve software systems to monitor and record carbon emission and to conduct trades in emissions.

Figure 3. Australia's regulatory structure



Source: CIIER Analysis.

The Energy Supply Association of Australia (ESAA) has estimated that, for the period 2003–12, expenditure of between AUD 15 billion and AUD 18 billion is needed for new distribution facilities in Australia, with an additional AUD 5 billion required for power generation facilities, AUD 3 billion for transmission facilities and AUD 3 billion on renewable energy generation, and that the changes to the structure of regulation in Australia will result in investment of up to AUD12 billion in new generating capacity.¹²

This investment will have flow on effects to the wider utility infrastructure market. Energy companies in NSW have indicated that they are ready to invest AUD 2 billion within the next few years under the right regulatory conditions.¹³

As governments work toward providing regulatory certainty and investor confidence returns to the area, there will be opportunities for Australian firms to provide software to manage and operate the new plant and equipment that must be

built, and other software opportunities to provide greater efficiencies and higher return on investment within existing operations.

The utilities market in Australia can be broken into the power generation and the distribution/retail segments. The following two tables show the approximate market shares for the major electricity generators and energy retailers.

Table 1. Australian electricity generation market share and ownership

<i>Utility</i>	<i>Ownership</i>	<i>Approx market share</i>
Macquarie Generation (NSW)	public	14%
Delta Electricity (NSW)	public	12%
Loy Yang Power (VIC)	private	8%
Eraring Energy (NSW)	public	8%
International Power Australia (SA)	private	8%
Tarong Energy (QLD)	public	7%
CS Energy (QLD)	public	7%
Yallourn Energy (VIC)	private	7%
Enertrade (QLD)	public	6%
Stanwell Corporation (QLD)	public	6%
Edison Mission Energy (VIC)	private	5%
NRG Flinders (SA)	private	2%
Snowy Hydro (NSW, VIC,CWTH)	public	2%
Intergen Australia (QLD)	private	2%
TXU Torrens Island (SA)	private	1%
All others	-	5%

Source: Department of Industry Tourism and Resources¹⁴

Table 2. Australian energy (electricity and gas) retail market share

<i>Retailer / Distributor</i>	<i>Ownership</i>	<i>Customers</i>
AGL	private	3.0 million
Origin Energy	private	1.9 million
Energy Australia (NSW)	public	1.3 million
Energex (Qld)	public	1.1 million
TXU (Vic)	private	1.0 million
Integral (NSW)	public	0.9 million
Western Power (WA)	public	0.8 million
Country Energy (NSW)	public	0.7 million
Ergon Energy (Qld)	public	0.6 million
Alinta Gas (WA)	private	0.5 million
Aurora Energy (Tas)	public	0.4 million

Source: Department of Industry Tourism and Resources¹⁵

Energy supply (gas resources)

The principle sources of supply of domestic gas in Australia include the Esso/BHP joint venture off the Gippsland Basin which supplies much of Victoria's gas; the Cooper/Eromanga Basin in South Australia operated by Boral which supplies gas to South Australia, Queensland and New South Wales; and the North West Shelf project operated by Woodside Petroleum which domestically is only supplying Western Australia at present.

Despite Australia's huge gas reserves and growing domestic demand, the domestic gas sector has been hampered by a reluctance to commit to investments in pipelines and other essential infrastructure to take advantage of these reserves.¹⁶

Energy demand (efficiency)

The issue of more efficient energy use is receiving considerable attention in the energy demand (energy efficiency) segment, with much of the activity being driven by concerns about sustainable energy and global warming. It is recognised that an important response to this concern is to reduce or limit growth in energy consumption through approaches such as greater efficiency.

It is also recognised that greater efficiency in energy use has potentially significant positive flow on effect to the economy. Allen Consulting (2004) noted that:

Achieving annual energy savings of 1% beyond 'business as usual' (...) would deliver an increase in [economic] consumption of approximately 0.18% by 2014 (\$1 billion), while reducing electricity prices to end users and saving 16.5 Mt CO₂ emissions of greenhouse gases.¹⁷

Government approaches have increased the increased focus on demand management. For example, the Victorian government mandated that all new homes built after July 2005 must be 5-star energy rated, and that the rollout of interval meters for all electricity customers should commence in 2006.¹⁸

The introduction of interval metering will have ramifications for IT. For example, the National Electricity Market Management Company (NEMMCO) have noted that there is a 'need to change the way metering data is managed, to minimise costs and risks, and to ensure appropriate levels of audit and traceability for the increased data.'¹⁹

NEMMCO are considering significant change to the data model to deal with interval metering, and that is likely to require substantial software development to realise the potential gains.

The CSIRO, as part of its Energy Transformed Flagship project, has set the goal of achieving big gains in energy efficiency by 2020. It is seeking to halve energy losses in end-use processes, double fuel efficiency and expand the use of gas (including hydrogen) in vehicles.²⁰ These developments may bring significant

opportunities for software suppliers able to contribute to energy efficiency and demand management techniques, in the built environment, plant performance assessment, billing or embedded systems.

International energy markets

Despite the impacts in some regions of over-regulation or deregulation, business cessations and greenhouse gas policies, all markets are displaying solid growth prospects and all are displaying huge demands for investment.

The US Department of Energy predicts that primary energy consumption in the US (the largest market) will grow from 98.2 quadrillion Btu to 133.2 quadrillion Btu over the period 2003 to 2025 (1.4% pa), and that petroleum and electricity will be the energy sources with the greatest growth over that period.²¹ Growth in final energy consumption will be 1.3% pa over the same period.

US utilities have shifted from their earlier strategy of global expansion and there is now a trend toward regionalisation, with firms seeking to expand within their own region.²² This is reinforced by the state-based regulatory landscape in the US.

Carbon trading is also a strong likelihood in the US, despite its not ratifying the Kyoto Treaty, as a coalition of nine northeast and mid-Atlantic states are progressing implementation of a 'cap and trade' plan under the Regional Greenhouse Gas Initiative (RGGI).²³

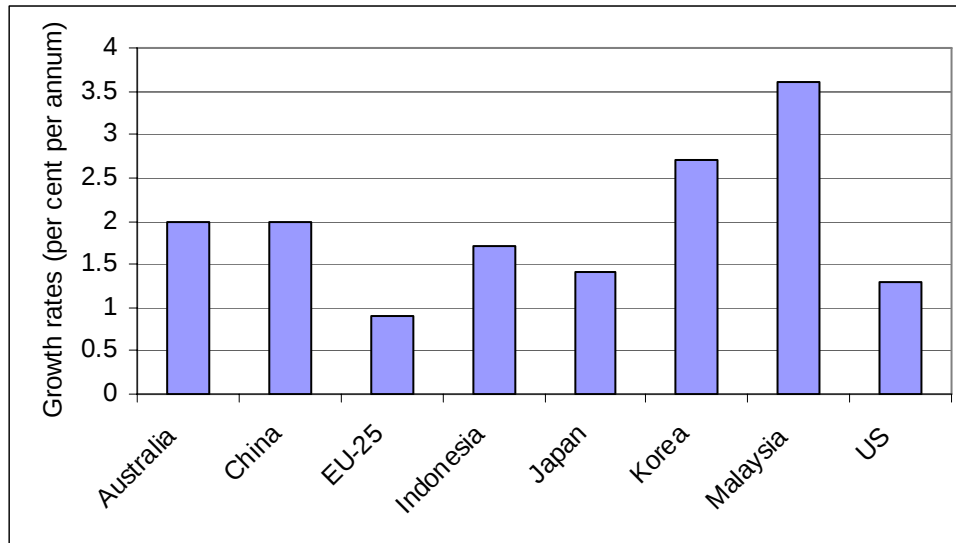
The overall US trends of increasing growth in consumption and the pressure for investment in infrastructure and services is somewhat similar to that of the Australian utilities sector. Thus software firms with a demonstrated ability to add value in the Australian context, particularly in areas that offer improved investment attractiveness, may have parallel opportunities in the US markets.

The European Union (EU), with its limited natural energy resources, its slower population growth and its strong commitment to greenhouse gas reduction targets, will have a much slower growth in demand for energy than elsewhere.

The 25-member Union's final energy demand is anticipated to grow at only 0.9% pa to 2030.²⁴ Electricity is the fastest growing final energy source—currently growing at 1.6% pa. However, Europe's demand for investment in the energy sector is substantial, with the need to increase electrical generation capacity from the present 580 GW to 950 GW by 2030.

In addition, the EU anticipates that the primary fuels for electricity generation will change substantially, away from coal, oil, and nuclear, to gas and renewables. This substantial demand for investment and the commitment to change its energy mix suggests that there will be significant investment in infrastructure and, as a result, demand for software.

Figure 4. Predicted growth rates in final energy consumption to 2020



Source: ABARE, APEC, US DoE, European Commission.

The Asia-Pacific region already accounts for 29% of global net consumption of electricity, with the nations with the greatest generation capacity being China, Japan, Russia, South Korea, and Australia²⁵. An overall energy deficit in the region, combined with strong economic growth, make it a crucial market for utility firms.

Rapid population and economic growth in the Asia-Pacific, particularly in China and India, presents opportunities for software companies whose product can play a part in the overall infrastructure growth needs of these nations.²⁶ Final energy demand in the APEC region is expected to grow at an overall rate of 2.2% pa,²⁷ and APEC predicts energy investments of USD 3.4 trillion to USD 4.4 trillion will be needed in the region over the 20-year period through 2020. Nearly half the total, USD 1.9 trillion to USD 2.2 trillion, will be required for power generation and transmission capacity, and some USD 0.5 trillion to USD 0.7 trillion will be needed for domestic oil and gas pipelines.²⁸

APEC's regional electricity demand is expected to increase at 3.2% pa to 2020, with China contributing 30% of this increase in demand.²⁹

The energy software market

Predicted increases in global demand for both energy and changes to the supply, such as economically efficient and environmentally sustainable processes, and associated investment in energy infrastructure will increase demand for relevant software. As new investments are planned and implemented there will be a corresponding demand for software many areas including switching equipment, maintenance and planning software, asset management software and enhancements

to customer and billing software to handle new pricing scenarios for demand management.

There are limited signs that the market for utilities software is becoming more positive. In a recent survey of 42 primarily US based software firms that focus on the energy sector, Skipping Stone Consultants found signs of stability and growth after some difficult years. They also identified a trend away from developing all-in-one solutions, with only 15% of the vendors indicating a focus on providing an end-to-end solution.³⁰

Energy firms no longer want to spend USD 20 million on a SAP system; they want to spend USD 1 million at Siebel for a knowledge management system, and USD 1 million at another vendor for a customer system, and so on.³¹

This suggests a trend toward best-of-breed components, integrated using sophisticated middleware technology. Software vendors who are able to offer niche products that are excellent in their field will find willing customers, provided that the software is equipped with standard interfaces and is capable of integration.

IDC estimated that spending on 'contestable' software (i.e. excluding operating systems, platforms and standard desktop systems) in the Australian utilities segment was AUD 140 million in 2004, rising to AUD 144 million in 2005.³² This is consistent with the general upswing in expenditure occurring in the US,³³ and is indicative of overall trends in the marketplace.

The customer base for energy software

Energy utilities themselves are obviously a major user of utility software and supply chains may also represent market opportunities for software companies operating in energy or related verticals (e.g. transport). Access to market is often mediated through third parties. Large infrastructure projects undertaken by utilities can often be decided by a competitive bidding process with consortiums of engineering/integration firms and large suppliers bidding for the work.

Firms such as GHD Pty Ltd, Sinclair Knight Mertz and Connell Wagner are just some of the large engineering consultancies operating in Australia who design energy generation and must make decisions about instrumentation and control equipment to be used in projects and consequently the software to be used.

Thus, depending on the nature of the software and its relationship to specialist hardware, access to markets for software providers is often through these direct suppliers to the industry.

Real time automation and controls

The real time automation and control (RTAC) segment covers all of the electronic equipment and software used for monitoring and controlling the distribution of energy. This includes supervisory control and data acquisition (SCADA), energy management systems (EMS), distribution management systems (DMS), distribution

automation (DA), remote terminal units (RTUs) and metering equipment; and communications systems.³⁴ All of these systems utilise software in some form. In some cases it is used to control specific hardware, such as solenoid operated valves or electrical switching equipment, and thus is an integral part of the equipment. In the US, expenditure on RTAC by electric utilities was predicted by Michael Marullo to grow from USD 312 million in 2004 to USD 537 million in 2007, a growth rate of 14% pa.³⁵

Equivalent market size data on the Australian and other regional markets has been difficult to obtain, however given that the general trends in energy use are fairly consistent, and given the expectations of large investment in Australia, we would expect a somewhat similar growth pattern in RTAC expenditure in Australia and other regional markets.

Aspects of the RTAC market receiving particular attention are the area of interval metering and demand management systems. The push in this area is coming from governments seeking to cope with increases in demand without the expense of installing new capacity.

Rollouts of interval metering for gas consumers are already underway in Australia. In Western Australia, consumers of gas over 10TJ must have interval metering installed if they change retailers.³⁶

Typically, large consumers of energy all across Australia have interval metering installed, but Victoria's Essential Services Commission is the first body to mandate electrical interval metering for all consumers.³⁷

The consequence of this is that large volumes of metering data must be gathered, stored and utilised.³⁸ Current systems will require change to store and process this extra data, and we expect significant IT investments to occur in the utilities, the regulators and the manufactures of the meters—which will be required to make their meters compatible with the evolving IEEE-SCC31 meter interfacing standards.

MNCs dominate this market segment. Such companies as ABB, Areva, GE Energy, Open Systems International and Siemens are major suppliers in the US market,³⁹ and foreign companies are also active in the local market.

For example, in 2002 the Australian Gas Light Company (AGL) installed turbine controller equipment from GE, SCADA from ALSTOM, and a unified operator interface from Yokogawa.⁴⁰

Australian software firms are only moderately represented in the segment, and those that do exist face stiff competition from these foreign firms with strong relationships to manufactures of the electrical hardware (e.g. transformers, switches, meters) used in the utilities industry.

Of the seven major manufacturers (the seven top firms based on total revenue) in the Australian electrical equipment manufacturers industry, only one is Australian owned and headquartered (i.e. Oliver J. Nilsen Ltd), other players with significant manufacturing bases and headquarters in Australia include Tyree, although IBIS do

not include them within their top seven grouping.⁴¹ This lack of local manufacturers of utility hardware must tend to limit the linkages that Australian software firms can establish.

Table 3. Australian firms in the RTAC market segment

RTAC	
Citect Pty Ltd.	An Australian listed firm, with 2004 revenue of \$61.5 million, focusing on industrial automation software and SCADA
Datec	Australian developer of a range on utility focused products including metering, billing and energy management
Hi-Tech Software	Involved in an indirect way through the provision of C-compilers and embedded systems software for the industrial devices and remote metering market
Layson Pty Ltd	A manufacturer of complex electrical devices and controllers, such as data loggers and stepper motor controllers. These devices require embedded software to operate and exchange data with master devices and a remote meter reading system

Source: CIIER Analysis.

One Australian firm, Queensland based Citect Pty Ltd, stands out as a large Australian company operating in this field. It achieved \$61.5 million in revenue in 2004.⁴² Citect develops SCADA and industrial automation software for utilities, including energy and water as well as for other sectors.

Citect has received assistance from Queensland Government Department for State Development and Innovation, via a Queensland Investment Incentive Scheme (QIIS) agreement, and has seen significant growth.⁴³ Citect has sales offices and representatives around the world, and Citect's approach to market access is to develop multi-level relationships. It maintains relationships with hardware manufactures and offers Citect's software as an integral part of a manufacturer's hardware, thus ensuring sales when the manufacturer's hardware is selected.

Geospatial and field automation solutions

Applications in the geospatial and field automation solutions (GFAS) segment are focused on coordinating and controlling network maintenance and upgrade activities. It includes such things as geographic information systems (GIS), automated mapping/facilities management systems (AM/FM), mobile computing systems, outage management systems, and workforce management systems.

In the United States, the expenditure on GFAS by electric utilities was forecast to grow from USD 215 million in 2004 to USD 471 million in 2007, a growth rate of 21% pa.⁴⁴

We would expect a similar growth pattern in Australia as the anticipated growth in distribution facilities will increase demand in this market segment.

In the US market, large MNCs are dominant, with Autodesk, ESRI, Intergraph and GE Energy the four top suppliers.⁴⁵ All have a presence in the Australian market. There is a vast array of vendors in some application areas within this segment, such as outage management and mobile applications, but there are now signs of consolidation and mergers.⁴⁶

There is little evidence that Australian producers play a significant role in this market segment. For example, South Australia's state electricity utility ETSA recently selected US firm Intergraph's outage management and mobile workforce management system for use by their field personnel.⁴⁷

Similarly, Victorian headquartered utilities systems integrator TUSC, offers a range of services around the integration of such things as SCADA, distribution management and workforce management.

TUSC nominates a single Australian firm, Citect, as a supplier of equipment. Its other partners, MSDI, SNC Lavalin, and GE-Fanuc are all foreign-owned.⁴⁸

Table 4. Australian firms in the GFAS market segment

<i>Geospatial and field automation</i>	
Geomatic Technologies	An Australian firm providing consulting and IT solution in geo-spatial asset management in rail and motorway infrastructure, but not currently in energy.
Lisasoft	An Australian firm developing GIS integrated software tools for the utilities, telecommunications and other markets.
Geometry	Developers of geo-spatial information management systems.

Source: CIIER Analysis.

Australian based producers involved with geospatial technology are not typically focused on the energy and utilities market. Some Australian companies, such as Geomatic Technologies and Lisasoft, provide solutions that may have potential to be adapted to the utilities context, but this is not certain and there is little evidence of a strong focus on this sector.

Moreover, the Cooperative Research Centre for Spatial Information (CRCSI) does not seem to be undertaking research with direct application within the utilities market, and an examination of its commercial partners reveals no representation from the utilities sector.⁴⁹

Enterprise asset management systems

EAM systems in the energy industry are used to manage and control the lifecycle of the hugely capital intensive assets. Asset management systems can be used to develop capital spending plans for equipment lifecycles, optimise preventive maintenance, for reliability centre maintenance, root cause analysis, modes of failure analysis and so on.

The worldwide market for EAM was USD 1.6 billion in 2004, and it was forecast to grow at 3.1% pa to USD 1.9 billion, in 2007.⁵⁰

Table 5. Australian firms in the EAM market segment

<i>Asset management systems</i>	
Hardcat	Australian developers of asset tracking and maintenance management software.
Mincom	Mincom is a large Australian consulting and software firm in the mining and utilities sectors. Mincom offer ERP systems, asset management and trading systems.
EMS Solutions	Developers of asset and works management software. The asset management software is used to manage the full lifecycle of the expensive hardware assets. EMS counts over 12 electrical distribution firms as its customers.

Source: CIIER Analysis.

Asset management systems are receiving attention as utilities, constrained by lower prices for their energy, attempt to obtain improved return on investment in their assets. The systems currently on the market have evolved over time. In the past, multiple systems were needed for the unique characteristics of different asset classes. This resulted in functional silos.

Platforms with broader capability are now available, with a trend developing for convergence with ERP systems, as explored in the chapter on the manufacturing market vertical. Leading EAM systems (including those supplied by Mincom, Indus International, MRO Software and Datastream) and integrated asset-intensive ERP suites (including SAP, PeopleSoft and EnterpriseOne) now offer a combination of functions that span work management and asset management, making the use of separate systems unnecessary.⁵¹

Australian company Mincom is a medium sized and successful player in this market. Other Australian companies we have identified are significantly smaller and, although offering product in the asset management market, do have a significant presence in enterprise level applications, with their offerings appearing to be positioned at a more mid-market level targeting customers looking for less complex and expensive solutions.

Trading and risk management systems

Trading and risk management systems (T&RMS) are designed to allow energy companies and traders to interface with brokers and conduct trades, to view their financial exposure to trades, manage forward contracts, conduct ‘what if’ analyses, examine physical limitations on trades (e.g. gas capacity, storage levels and volumes), and show currency and pricing conditions.

Deregulation and competition have forced utilities to manage energy supply pricing in a more sophisticated way, with both long term contracts and spot pricing occurring together, and to manage the potential downside risk of those trades. In addition, there is an emerging trade in carbon credits. This has led to a market for trading and risk management systems.

This market segment in Australia seems to be somewhat fragmented, with a big role played by systems integration and consulting firms (e.g. Infosys, Accenture) which offer services to integrate the various components needed to achieve an comprehensive system.⁵²

Foreign software producers in this market include such companies as KWI, OpenLink, Allegro and SAS. British firm KWI evolved from a consulting firm specialising in designing trading techniques, to developers of trading platform software.

There appears to be little involvement in this segment of the big names in energy systems (e.g. ABB and Siemens), nor do we see a large presence from players in the ERP world (e.g. SAP and Oracle). This adds weight to the view that this market segment is in an early stage of growth, with niche players currently making the running, and large consulting firms conducting the integration.

Table 6. Australian firms in the T&RMS market segment

<i>Operational and financial risk management systems</i>	
Mincom	Mincom is a large Australian consulting and software firm in the mining and utilities sectors. Mincom offer ERP systems, asset management and trading systems
The Marketplace Company	M-co provide consulting services and IT solutions to regulatory authorities, governments and utilities wishing to implement wholesale energy trading markets and green energy markets
Risk Management Technologies	Producers of enterprise-wide, risk, compliance and knowledge management systems and chemical risk management software and services

Source: CIIER Analysis.

Mincom offers a product in this segment called 'EnergyPoint'. Another Australian company, the Marketplace Company, is not strictly a producer but rather a consultant on energy markets and trading. They could potentially be in a position to tread the same path as KWI and convert their intellectual capital into intellectual property in the form of packaged software systems.

With the market in an early stage of growth, and as trading and risk management becomes a more important feature of the Australian and world energy landscapes, there are opportunities for Australian firms to participate.

Billing and customer information systems

Billing and customer information systems (BCIS) are software platforms that support utilities' revenue collection process and customer interaction. In the 1980s and early 1990s, CIS platforms tended to be custom made, by the likes of IBM and Anderson Consulting, to suite particular business needs.

The cost of these projects could be in the tens of millions of dollars, and the failure rate was high.⁵³ In the late 1990s, off-the-shelf solutions evolved to reduce the implementation risk. The segment now has a significant number of new entrants, partly as a result of utilities trying to productise their custom made BCIS solutions.

Table 7. Australian firms in the CIS market segment

<i>Customer information systems</i>	
Datec	Australian developer of a range on utility focused products including metering, billing and energy management
Prophecy International	Australian developers of utility customer information systems (CIS) for the worldwide utilities industry, with customers in transport, government, electricity retailing and water utilities

Source: CIIER Analysis.

This, and the slowdown in the US market of the pace of deregulation, has caused a substantial contraction in the market, with utilities wary of the massive expenditures of previous years. Major utility CIS installations have dropped from 5 to 10 per year in the late 1990s to an average of less than one per year since 2000.

Evidence of the effect of the slowdown can be seen in Anderson Consulting's decision to leave the segment in the late 1990s.⁵⁴ SAP is still a major player in this market, and is now licensed by more than 500 utilities.⁵⁵

It appears, given the conditions operating in this segment and the state of the competitive environment, that firms operating in this area will face long and difficult sales cycles so long as SAP maintains this dominance.

Energy efficiency in the built environment

This market segment includes software designed to ensure that energy usage in domestic and commercial buildings is minimised, and includes computer aided design and mathematical modelling to assess the energy usage characteristics of buildings. This is a smaller market, focused primarily on architects and engineers.

Given the apparently early stage of development in this market it is difficult to identify which are the major players. In Australia, the Victorian government is a player with its FirstRate software package, developed to provide architects with an affordable energy analysis tool that could accurately quantify the energy 'Star Ratings' of building proposals. When a government decides to commission specialised software development, it is a possible indication that satisfactory commercial applications have not been identified or are not available.

Another company specialising in mathematical modelling software, with direct application to energy modelling, Hearn Scientific, offers a product developed with the CSIRO. Since this market is in the early stages, competition is limited. Nevertheless, we would expect large, dominant companies, such as Autodesk, to be looking to build or acquire this capability to fill out their CAD product suites.

Table 8. Australian firms in the energy efficiency market segment

<i>Energy efficiency: built environment</i>	
Hearn Scientific	An Australian developer and distributor of a range of software utilising complex mathematical algorithms for modelling behaviour. Their offering includes a product developed with the CSIRO called Energy Express, which is designed to allow architects and engineers to model energy efficiency in the built environment.
First Rate (Sustainable Energy Authority Victoria)	Although not a software firm, the Sustainable Energy Authority has developed and markets energy rating software for builders and architects.

Source: CIIER Analysis.

Operational efficiency systems

Systems in this area include data loggers, environmental sensing equipment and modelling software to optimise the real-time use of energy. Once again, the market appears to be quite new and unstructured. It is an area where environment and energy consultants play a significant role. The involvement of Murdoch University in the development of RAPSIM is evidence of linkages to publicly funded institutions, and demonstrates the requirement for sophisticated specialist knowledge to provide the initial understanding, before product development can occur.

There is no information on the size of the operational efficiency systems (OES) market, and the product suite does not appear to have formed into a set of well known functions and applications. It is, however, an area that we expect will become more important over time, and an area where consultant knowledge may be successfully productised.

Table 9. Australian firms in the OES market segment

<i>Operational efficiency</i>	
RAPSIM (Murdoch University)	Murdoch University in conjunction with Research Institute for Sustainable Energy (RISE) have developed a software simulation package for remote area power supplies called RAPSIM
Energertics	A consulting firm offering strategic energy procurement, energy efficiency and Greenhouse consulting services. As an adjunct to this service they offer energy rating software to their customers
Datec	Australian developer of a range on utility focused products including metering, billing and energy management
Hi-Tech Software	Involved in an indirect way through the provision of C-compilers and embedded systems software for the industrial devices and remote metering market
Layson Pty Ltd	A manufacturer of complex electrical devices and controllers such as data loggers and stepper motor controllers. These devices require embedded software to operate and exchange data with master devices and a remote meter reading system

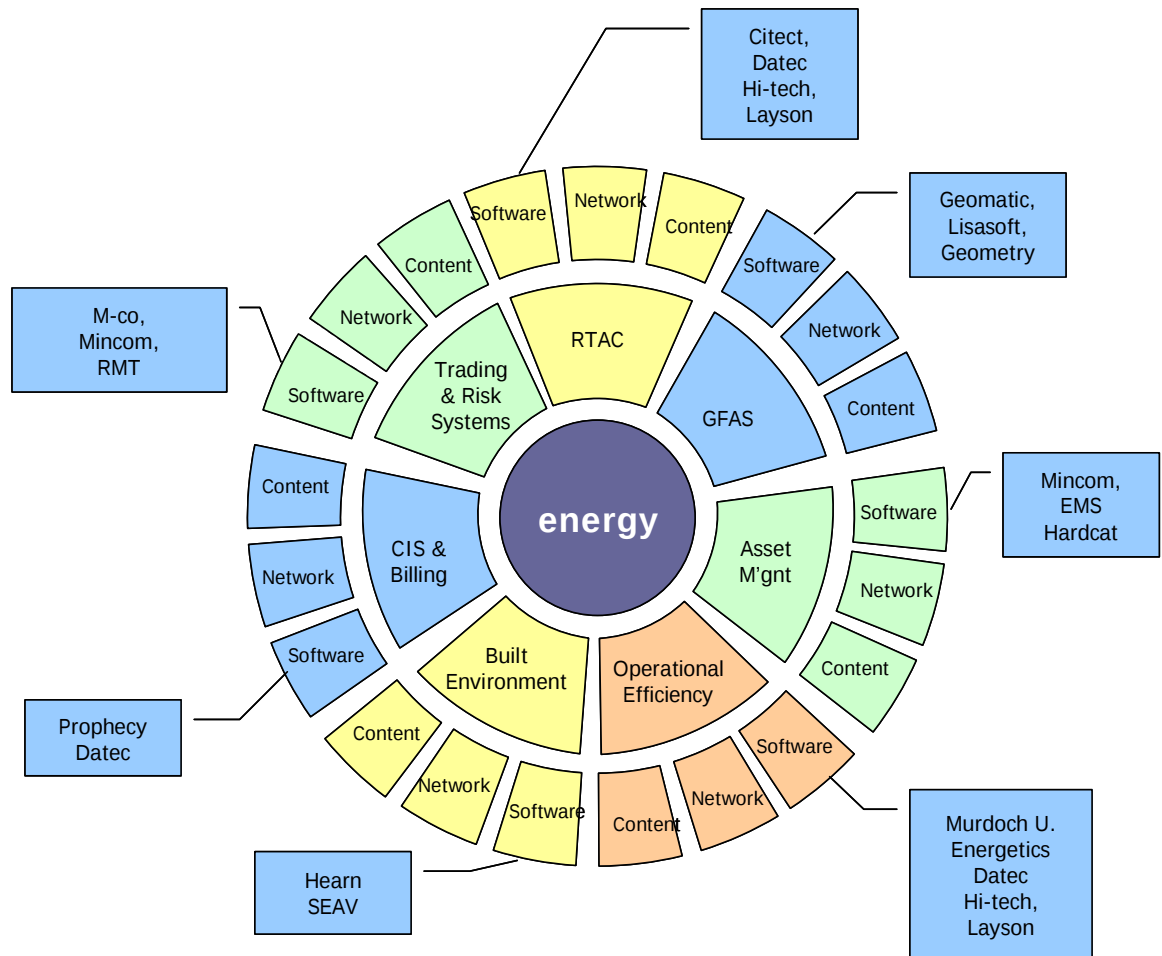
Source: CIER Analysis.

Energy software suppliers

The energy software vertical market map shows how these firms are distributed across the various market segments. The lists are not exhaustive.

The potential for opportunities in the energy market are good, because it is likely that governments, both in Australia and overseas, will increasingly focus on the economic benefits and the potential reduction in expenditure on infrastructure that can be delivered by more efficient energy use in both domestic and industrial settings.

Figure 5. Energy vertical software market map



Source: CIIER Analysis.

Innovation base and support infrastructure

As noted earlier, Murdoch University and the CSIRO have played a role in the development of software for the energy market. This linkage stems from the highly specialised mathematical modelling needs of the software. The CSIRO's Energy Transformed Flagship Program is also playing a role in the future of Australia's energy sector, with CSIRO undertaking research into low emission energy, low emission electricity, and the so far under-utilised technique of distributed electricity generation.⁵⁶

This research is still in the early stages, but it is reasonable to expect that any technologies developed will require sophisticated control technology and will provide opportunities for Australian software firms in the development and application of this technology in the future.

The Cooperative Research Centre for Spatial Information (CRCSI), on the other hand, does not appear to have a focus on the opportunities for the use of geospatial technologies in the energy sector at this time. However, the CRC for Integrated Engineering Asset Management (CIEAM) has developed models and decision systems, sensors and diagnostics relating to asset management, with a focus on utilities and process manufacturing.⁵⁷

Energy market conclusions

Investment in both the utilities and the energy demand management sectors is likely to increase in the coming years, providing opportunities in this vertical market for software firms.

Within the utilities sector there are several Australian firms positioned to take advantage of the opportunities in the RTAC segment (e.g. SCADA and Interval Metering) as well as trading and risk systems, and asset management systems. The demand for all of these systems will continue to grow, so apart from sometimes strong competition, market conditions look positive.

Australian software firms looking to increase their presence in these areas may find that establishing strong relationships with the manufacturers of electrical and gas hardware (e.g. transformers, switches, meters, etc.) will help them to participate successfully in the market.

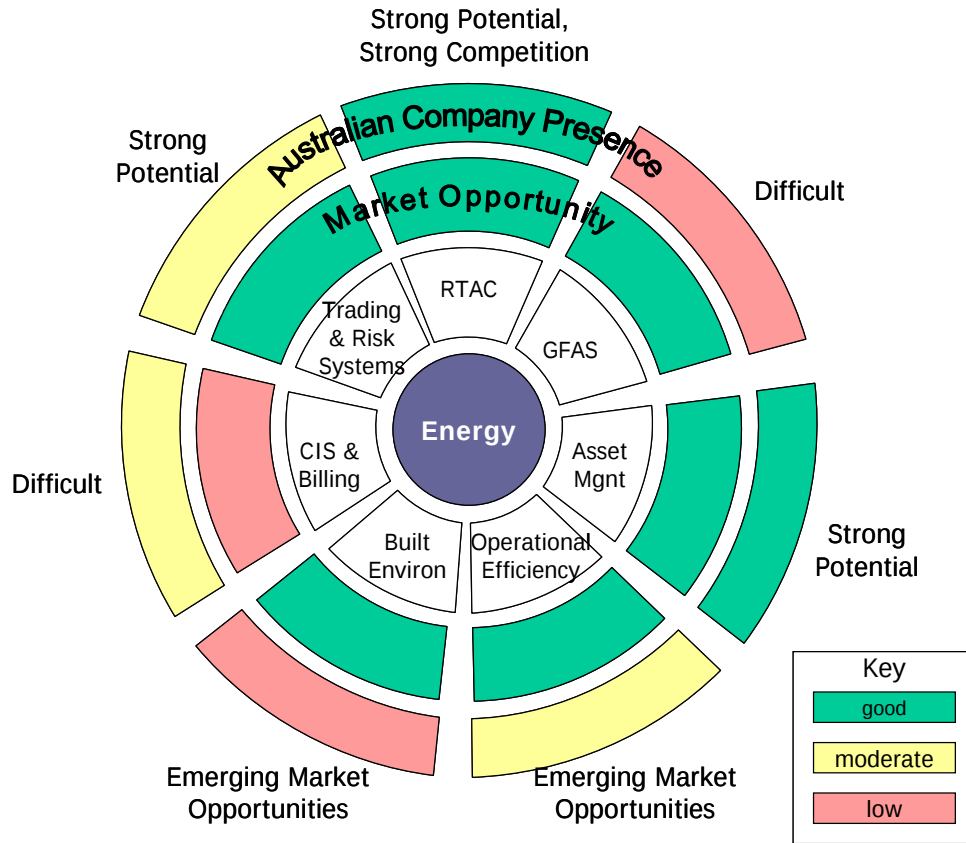
Table 10. Overall SWOT analysis of Australian energy software firms

Strengths	Several Australian firms are well positioned within the RTAC, T&RMS and EAM segments.
Weaknesses	The lack of electrical hardware manufacturers in Australia reduces the opportunity to establish links with these important players. There is a lack of Australian producers in the GFAS segment. Geospatial research bodies seem to have low exposure to the energy sector as opposed to other areas.
Opportunities	RTAC trading systems, EAM systems; risk management systems; and demand management are all likely to be growth areas as investment in energy rebounds. Mandated rollout of Interval metering in Victoria offers potential opportunity for firms involved in the metering space within the RTAC segment. Increasing focus on energy efficiency as Australia begins to grapple the problem of climate change provides opportunity right across the energy efficiency segment. Advances made by the CSIRO in energy efficiency and new generation techniques may provide opportunities for Australian software firms which are positioned to make a contribution.
Threats	The greatest threat in the utilities area is competitive pressure from large conglomerates, such as ABB, GE and Siemens. They can develop both software and electrical hardware, and offer bundled packages – something unavailable to smaller Australian software firms. Despite a strong Australian company presence, and good growth potential in the RTAC segment, foreign competition in this area is also very strong.

Source: CIIER Analysis.

In the GFAS segment, Australia has a number of spatial information firms that could participate in this area, but presently do not. The potential also exists for these firms to team up with other firms supplying asset management systems, and thus add a geospatial element to these packages, and potentially take a lead in both areas.

Figure 6. Potential for Australian software firms within the energy market segment



Source: CIIER Analysis.

The increasing focus on sustainable energy will stimulate innovation in the energy efficiency segment. The market for architectural products for designing energy efficient buildings and determining energy ratings will continue to grow, but we expect strong competition to come from the likes of Autodesk and other CAD package developers.

In the area of operational efficiency, the opportunities are again that of a new and unformed market. Those firms which can productise the specialist knowledge resident in the consulting firms and universities are likely to be the successful players in these areas.

Health

The application of software within the health sector ranges from embedded software that drives IV fluid pumps, through roster systems, to software for coding of admissions and cost allocation. The various software application segments can be categorised into broad groups, including:

- clinical (e.g. clinical systems, GP systems)
- clinical support and other (e.g. pharmacy, pathology, radiology, allied health, therapies, nutrition);
- patient administration (e.g. PAS systems, GP practice management);
- finance, supply and administration (e.g. procurement and supply, payroll, claims processing);
- infrastructure (e.g. security, messaging); and
- medical devices (e.g. hearing aids, scanning microscopes, imaging and image manipulation).

The health software product system

The health software product system has a concentration of powerful players on the demand-side, with national and state health authorities, health insurers, general practitioner and pharmacy groups acting as demanding clients with high expectation for the performance and integrity of systems.

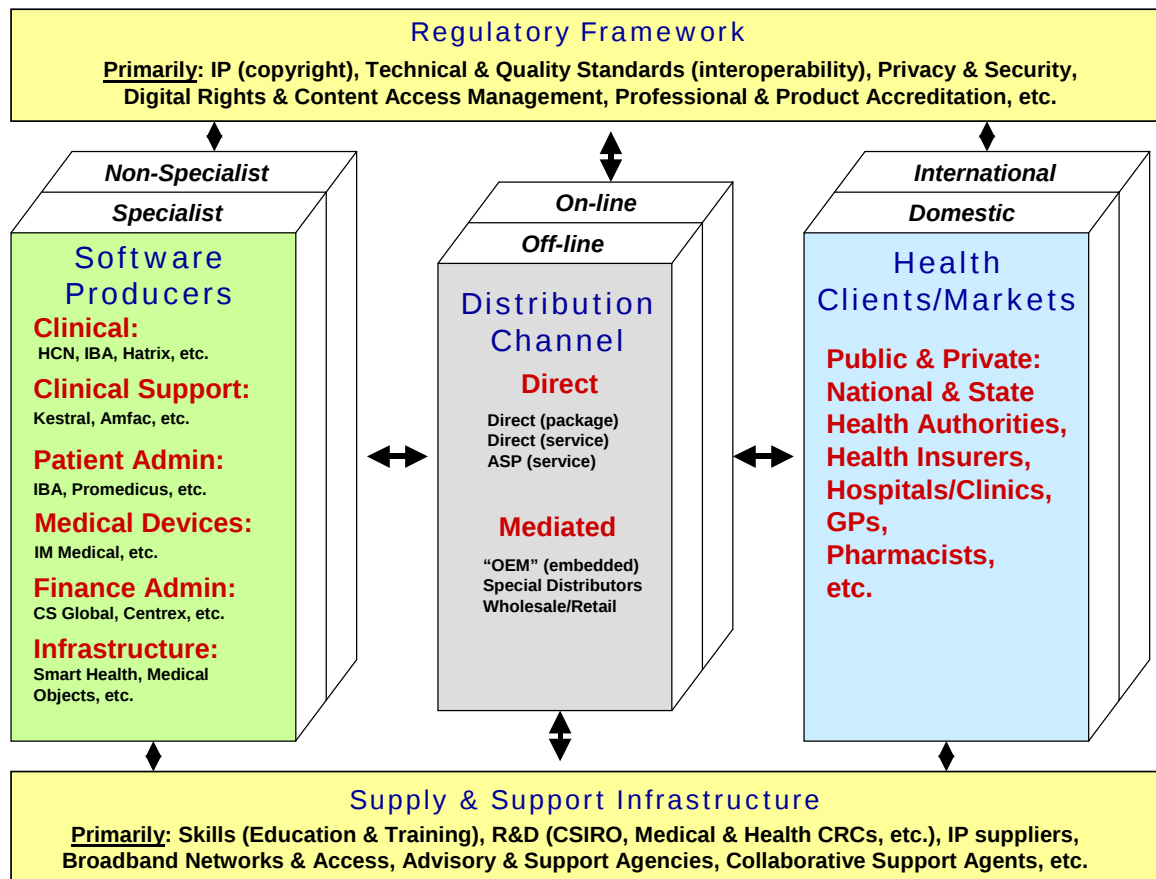
In many countries, health care and the adoption of e-health is driven by the public sector and dependent upon public funding and government initiatives. In many cases, e-health programs are coordinated centrally, adding to demand side concentration and power.

There is also a range of private sector clients (e.g. private hospital chains, insurance firms and health management organisations), and the roles they play in the adoption of e-health and health software markets vary from country to country. In some cases they are leaders in innovation, and followers in others.

However, the overarching need for interoperability and integration within the health care system encourages public and private sector clients and producers to work closely together. Collaborative linkages between producers and clients, and within producer and client clusters, are crucial for market entry, innovation and development.

Given the size and complexity of the e-health market, smaller software firms often find it necessary to partner with major providers and systems integrators as a path to market. These mediated channels are dominated by major multinational firms.

Figure 7. The health software product system



Source: CSES Analysis.

The healthcare market is very complex and varied, with significant potential benefits to accessing information and connecting patient records across the system (e.g. pharmacies, doctors, hospitals etc.) while maintaining privacy.

Integration of the system at the national level (or supra-national level in Europe) is one of the principal goals of e-health and given the many and diverse clients, standards play a crucial role. There are standards covering identifiers for patients, healthcare providers and products which can vary between jurisdictions.⁵⁸

Participation in standards bodies is an important part of operating in the e-health market, and when assessing export market opportunities software developers need to choose between standards blocs (e.g. HL7 versus the European openEHR for health communications).

The health product system also features non-commercial developers of software, especially among the research support base and clients (e.g. hospitals). As discussed elsewhere in this report, and as the examples of the Repatriation General Hospital and Cooperative Research Centres (CRCs) discussed below demonstrate, hospitals are one of the more common sources of non-ICT industry supply of telemediated software development and maintenance services.⁵⁹

E-health markets

This section examines key drivers and trends in the domestic and international e-health markets and their implications for demand for health related software. It identifies the centrality of major clients and differences between various national health systems.

Market drivers

The major driver of ICT investment in the health sector is the desire to fully utilise the capacity of ICT to reduce costs and improve the operational effectiveness of the health system. E-health is expected to reduce incidence of preventable illness, take pressure off hospitals, GPs and community care, reduce duplication of treatment and testing, reduce hospital re-admissions, reduce medication error, encourage and enable people to take more responsibility for their own health and enable the health system to be more responsive to community needs.⁶⁰

Until recently purchasing of health software tended to be localised, resulting in many different legacy systems using a mosaic of specialised software. The market for health software is now changing, moving from stand-alone software solutions towards establishing a set of software solutions that are interoperable. Software systems are becoming more sophisticated as the user base works towards greater integration of systems.

Patient management systems form the core of many e-health systems, and they are increasing in sophistication as attention is given to standardising the reporting of patient data and to privacy protocols.

In parallel, rapid progress is being made in integration of hospital management systems, which involves moving from individual hospital systems to a regional, state or national system.

Electronic transaction systems are rapidly emerging to connect medical services with health insurance and pharmacy services in order to facilitate payments, convey information and consolidate transaction data bases, thereby reducing costs and improving linkages.

While these trends are evident across developed countries, the market for e-health related product is very much determined by the nature of national health systems, the wealth of the country, the levels of funding provided by government and the role of the private sector in delivering health services.

The most sophisticated markets are in the richer countries of Europe, the United States, United Kingdom and Japan. But these markets also have the most intense competition, with more entrenched and established players. Because of market differences, e-health systems are being individually developed and customised to national health systems, making each national health software market different and narrowing international market opportunities.

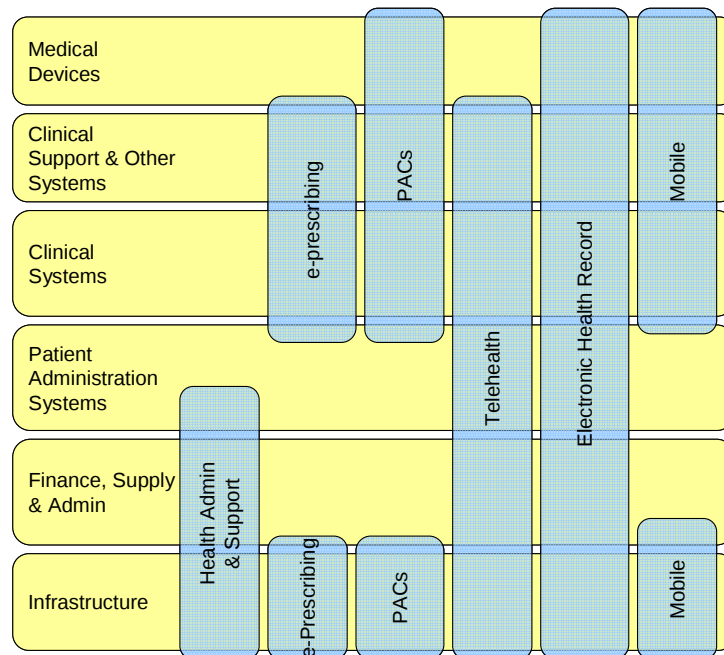
Dimensions of change

E-health is advancing on several fronts, which are all underpinned by a need to share health data between different organisations, systems and applications right across the sector. As a result, there are six key initiatives that are common to the e-health strategies of developed countries.

- E-prescribing—the end-to-end management of prescriptions from script generation to fulfilment, invoicing and cost allocation
- Electronic health records—sharing patient health data, including admissions records, treatment information and medication history, between health care providers for the purposes of providing consistent and efficient high-quality care
- Picture archiving and communications systems (PACs)—to store, archive and transfer medical images and other visual data, such as x-rays and ultrasounds
- Telehealth—the use of real-time video technology for emergency and clinical consultations
- Health administration and support—for achieving efficiencies in the support infrastructure, including health claims processing and supply chain efficiency
- Mobile health—mobile or remote health care technologies for such things as home based and rural care⁶¹

The relationship between these initiatives and the broad software product groups we have identified is shown in the accompanying figure.

Figure 8. Relationship between software segments and e-health drivers



Source: CIIER Analysis.

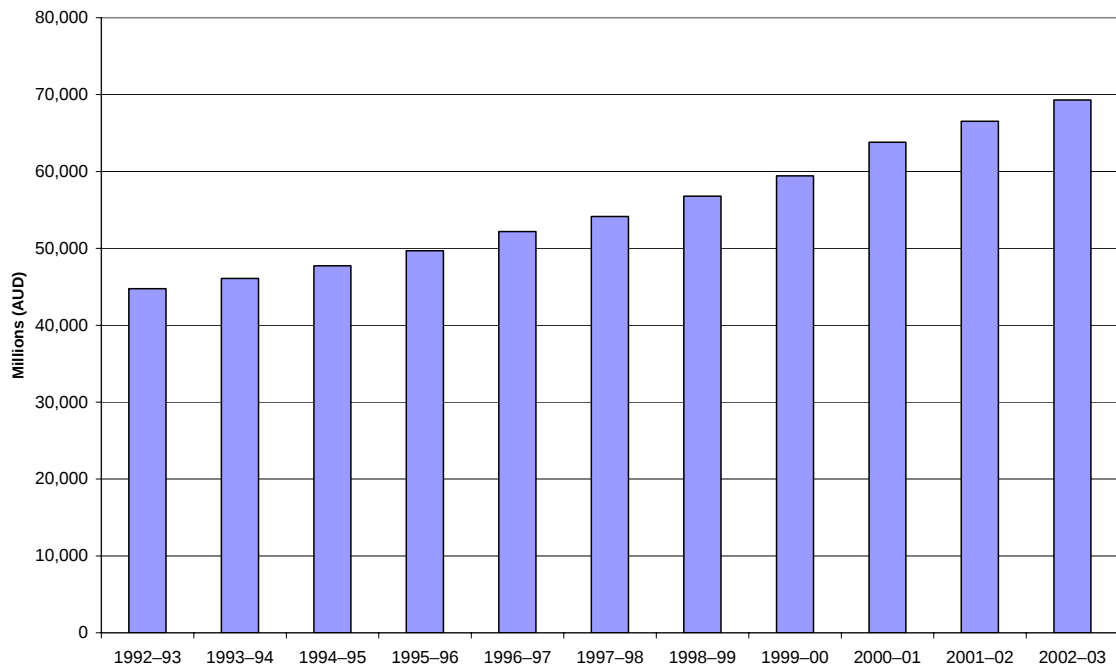
The e-health market in Australia

The Australian e-health landscape is complex. Both state and Australian Government health departments co-exist with rural and regional health care organisations, and a raft of other important stakeholders with varying degrees of autonomy.

Private hospitals provide about a quarter of all hospital beds in Australia. Private medical practitioners provide most non-bed medical services and perform a large proportion of hospital services alongside salaried doctors.⁶² Some private hospital groups are following a growth by acquisition strategy (e.g. Ramsay Health Care recently acquired Affinity Health, formerly Mayne Health)⁶³ and diagnostic groups (e.g. Sonic Health Care) are also seeking opportunities for growth overseas.⁶⁴

Such consolidations and expansion involve, and are made possible by, the adoption of ICT systems which provide necessary operational support.

Figure 9. Australian health expenditure



Source: Australian Institute of Health and Welfare⁶⁵

Note – Expenditure is in 2001-02 dollars.

Health expenditure in Australia increased in real terms at an average of 4.5% pa over the decade 1992–93 to 200–03. Total government expenditure grew at an average of 5.4% pa over the period, and accounted for 68% of the total health expenditure in 2002-03.

Non-government funding grew at 3.1% pa over the same period.⁶⁶ In 2002–03, there were 748 public hospitals operating in Australia offering 52 200 beds (66% of all beds in the hospital sector). Total days of hospitalisation for public health patients during 2002–03 amounted to 16.4 million.⁶⁷

During 2003–04, there were 525 private hospitals operating in Australia providing 7.3 million patient days and employing more than 48 500 people. Private hospital income reached almost \$6.3 billion.⁶⁸

IT solutions and e-health projects are being fostered to improve the efficiency of the operation of the health system and help reign in increasing costs. Frost and Sullivan highlight a general shift in focus within Australian health IT.

The mandate of IT solutions in the Australian healthcare sector has changed from administrative requirements as first priority in the 1990s, to clinical needs and healthcare delivery needs as first priority from 2000 onward. This is mirrored in the move from organisation-centric processes to patient-centric processes.⁶⁹

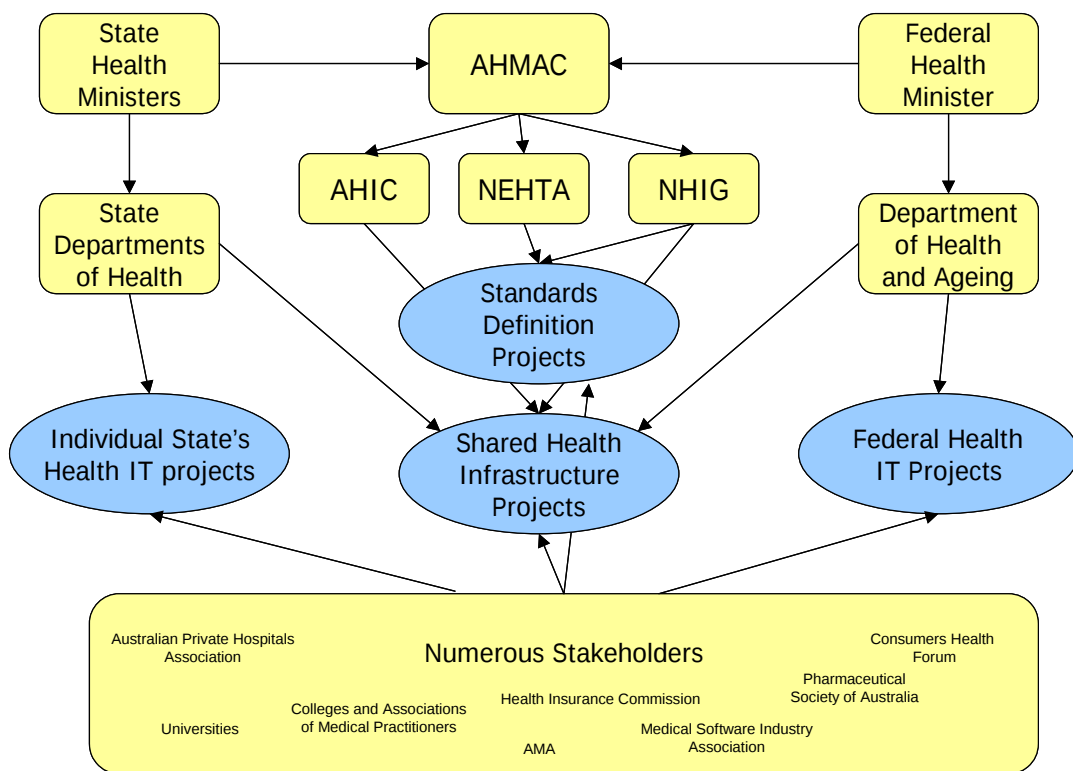
Because of the substantial public sector contribution to health care expenditure, the direction and pace of e-health is primarily driven by state governments and the

Australian Government, with contributions from the many stakeholders, including health insurance firms, private hospitals, pharmaceutical firms and others.

Several bodies have been created under the auspices of Australian Health Ministers Advisory Council (AHMAC) to help set national directions and goals.

Groups such as the Australia Health Information Council (AHIC), The National e-Health Transition Authority (NEHTA), and the National Health Information Group (NHIG) have been formed to help coordinate activities. Under the auspices of AHMAC, governments are also working to coordinate their activities in order to achieve greater shared benefit.

Figure 10. Relationship between government bodies and health IT projects



Source: CIIER Analysis.

Considerable investment is being made through initiatives designed to create greater national alignment and connectivity between Australia's various health markets, for example:

- national/centralised electronic health record—HealthConnect was allocated \$123 million in 2004–05 budget;
- medication history record—MediConnect, which is included within the HealthConnect budget;

- integrated health supply chain—the Health Supply Chain Reform Task Force;
- e-prescribing pilots in Victoria and Northern Territory;
- Picture archiving and communications systems (PACS)—with almost all states having independent initiatives to implement PACS systems in their hospitals; and
- development of a set of national health informatics standards called IT-14, which covers clinical data, imaging standards and supply chain messaging standards.

There is also significant expenditure by various state governments on general system improvements. The Victorian *HealthSmart* project, an AUD 323 million upgrade program for hospital systems, is an example.

These investments aim to provide interconnection between patient administration, clinical and finance system capability within and between hospitals and other health providers

By 2010, a large portion of the e-health system in Australia should have been implemented. Such a rapid pace of development provides a window of opportunity, but it can be expected to quickly narrow as the major contracts are concluded for this procurement cycle. For SME software developers such ‘lumpy’ markets can be difficult.

Computer use is high in the general practice market but the major focus is still upon financial and accounting functions. In 2002, computers were used in almost 90% of all Australian general practices and 95% of all specialist practices—with 72% using computer for financial management and accounting purposes, and just 57% using them for electronic patient record management.⁷⁰

The General Practice Computing Group (GPCG) was established in 1997 as the peak body for general practice computing in order to foster development. The Australian government contributed AUD 9 million to their 2001–05 work plan, with AUD 2 million targeted to standards development.⁷¹ The GPCG has had a significant involvement in a number of e-health initiatives, including:

- assistance with standards development, including electronic health record (EHR) archetypes and vocabularies;
- developing a GP software engagement strategy to assist software vendors with requirements;
- support for messaging applications;
- trialling the EHR in conjunction with the *HealthConnect* project; and
- support for the development of a software accreditation scheme for health.⁷²

In addition, the Australian Government Department of Health and Ageing is providing AUD 35 million to fund the Access to Broadband Technology for GPs program, which is designed to provide broadband access for GPs across Australia.

The high levels of ICT spending currently taking place in the Australian health market, and the government drive to implement standards and a shared e-health infrastructure, makes the Australian market very attractive for health IT firms.

A British study, conducted on behalf of Intellect UK, evaluated a number of foreign markets for British health IT firms looking to export and identified Australia as one of the most attractive markets (for British firms), having the right mix of high opportunity and moderate competition.⁷³

International and regional e-health markets

The international market for e-health related software is very much determined by the level of sophistication and nature of each country's health systems. The most sophisticated markets are the countries of Western Europe, the United States and Japan. However, these markets also have the most intense competition from entrenched and established players.

Table 11. Health market indicators for selected countries—2002

	<i>GDP Per capita (\$)</i>	<i>Number of Public Hospitals</i>	<i>Number of Private Hospitals</i>	<i>Health Spend per capita \$</i>	<i>Spend % funded by Govt</i>	<i>Spend % Private</i>	<i>Number Health IT Firms</i>	<i>Market concentration Top 10 firms</i>
Australia	27,614	748	549	2532	67.9%	32.1%	475	33.5%
Canada	29,235	1033	58	2792	70.8%	29.2%	450	25.6%
India	1050	10,560	4571	80	17.9%	82.1%	75	30.0%
Malaysia	9030	115	224	345	53.7%	46.3%	110	34.5%
NZ	20,764	85	360	1724	76.8%	23.2%	45	51.4%
UK	26,273	1227	200	1989	82.2%	17.8%	240	37.7%
US	36,056	1408	4402	5274	44.9%	55.1%	600	30.0%

Source: WHO⁷⁴; Australian Institute of Health and Welfare⁷⁵; Espicom as cited by Frost & Sullivan⁷⁶.

Europe

Health is a significant component of total economic activity in many European countries. In Germany, for example, health expenditures account for almost 12% of GDP, having increased at 1.8% pa between 1998 and 2003. The average spending increase across OECD countries for the same period was 4.5% per annum.⁷⁷

In March 2005, Frost and Sullivan reported that the European health IT market would double by 2010.⁷⁸ During 2003, the USD 3.13 billion health IT market grew by an estimated 9.7%, primarily driven by the implementation of Hospital Clinical Information Systems, a key building block in e-health. The public sector controls 75% of health IT procurement in Europe.

There are significant differences in structure and operation of the various health systems operating in Western Europe. Nevertheless, the general trend is toward greater integration. The French are implementing integrated systems, based on

extensive use of smartcard technology for patient authentication and accessing patient records.

The UK National Health Service (NHS) has been investing heavily in improving the capability of its health service and its underlying infrastructure. Its budget has grown from GBP 33 billion to GBP 67.4 billion since 1997, and the average spending per head of population has risen from GBP 680 to GBP 1345.⁷⁹

The e-health initiatives that form a part of this upgrade are receiving significant funding, with a budget of GBP 2.3 billion over the three years from 2004 to 2007, and a total GBP 6 billion over seven to 10 years.⁸⁰ UK initiatives include the following.

- Contact—an email and directory service
- NHS care records service—an electronic health record project
- Choose and book—an electronic service booking facility
- Electronic transmission of prescriptions—e-prescribing
- New national network & network upgrading
- QMAS supporting GP practices—a system to support quality of service
- Picture archiving and communications systems (PACS)
- Secondary uses service (SUS)—for improved data gathering and analysis

The prime contractor roles for many of these initiatives have already been granted to major multinational ICT suppliers, including BT, Accenture, CSC, Fujitsu, Atos Origin and Cable and Wireless.⁸¹ Software contractors include such firms as Cerner.

In general, the level of competition in the UK market in 2003 was high, with some 240 healthcare focused IT firms, and the top ten vendors taking 38% of the market.⁸²

An indicator of the relative sophistication of the UK market is the level of computerisation in general practice, which reached 98% in 2003.⁸³ Most practices are fully automated for the purposes of reporting patient demographics, prescribing and some pathology results. This is a very high level, and is a direct consequence of the removal of the government requirement for paper-based records in October 2002.

Competition in this sector of the UK marketplace is intense, with market leaders entrenched. There are more than 20 suppliers of GP patient management systems in the UK, and the top three have a combined 85% share of the market.⁸⁴

Australian firms wishing to benefit from investments in e-health in Europe will need to establish relationships with prime contractors, as well as ensuring that their products are recognised by the health care providers themselves. They must deal with public sector clients and be able to sustain long-term contract relationships.

With national standards and accreditation also playing an important role, partnering arrangements with major system integrators may be a solution for Australian SMEs, but these arrangements can place a smaller company in a weak position if the larger partner decides to change direction.

North America

The United States is the largest health care market, with aggregate and per capita spending significantly greater than other countries, even those with older population profiles.⁸⁵ The United States is unusual among OECD countries in not providing universal health coverage and in having a much greater reliance on private health insurance.⁸⁶

The Canadian health system on the other hand has similar characteristics to Australia's. It has a decentralised health care administration, with service delivery managed at the provincial and territorial level, and standards and funding managed centrally.⁸⁷

In both these markets, health care spending is increasing strongly, with spending in the US rising by 7.7% during 2003, four times the rate of inflation.⁸⁸ In Canada, per capita health spending increased by 3.4% pa over the decade to 2001, with an overall trend towards increasing costs.⁸⁹

United States

In the United States, more than 55% of health care funding comes from private sources. As a result, many decisions relating to IT strategies and investments are made within the private sphere, by health insurance firms and health management organisations (HMOs). Nevertheless, the Federal Department of Health and Human Services (HHS) is responsible for setting the direction of health systems interoperability in the US and rules relating to the methods of e-prescribing and Medicare electronic claims are being developed.⁹⁰

The Health Insurance Portability and Accountability Act (HIPAA) led to significant expenditure to ensure compliance to federal standards. For example, it promoted stringent security and privacy controls on health systems, resulting in increased expenditure on IT to address these requirements. HHS released a report in May 2005 on the future of IT in the US Health Sector, by the Lewin Group. It suggested that:

- widespread adoption of interoperable health IT should be a top priority for the US health care system;
- the federal government should use its leverage as the nation's largest single health care payer and provider to drive adoption of health IT; and
- private sector purchasers and health care organisations can and should collaborate alongside the federal government to drive adoption of health IT.⁹¹

In 2004, Gartner predicted an annual growth rate of 7% in the US health IT market, and expected the market to be worth USD 48 billion in 2006. Frost and Sullivan

observed in 2003, that insurance firms were the largest spenders on health IT in the US, with an estimated expenditure of USD 16.4 billion, while hospitals spent USD 15.9 billion and private practices USD 4.4 billion. The insurance firms have been early adopters of technology to ensure compliance with HIPAA regulations.⁹²

The goal of interoperability being promoted by HHS is consistent with the broad thrust of the e-health initiatives occurring in Australia, and Australian firms may well be able to offer product of value to the US market. Access to the US market might be improved by better government linkages, especially in the area of informatics standards.

This may help reinforce the credibility of Australia as a source of expertise. However, Australian firms entering the US market face strong competition as some 600 health IT firms are operating in the sector.⁹³

Canada

In Canada, e-health initiatives are controlled by a non-profit vehicle called Canada Health Infoway. It has CAND 1.1 billion available for investment in e-health infrastructure projects, of which CAND 158 million has already been committed to 17 projects.⁹⁴ These include:

- electronic health record and development of new informatics standards;
- provider registry program—which provides details about health provider services and capabilities, authentication and access mechanisms, and a unique patient numbering system;
- diagnostic imaging—an implementation of a shared services model for diagnostic imaging;
- drug information systems—which provide online access to patient medication data; and
- national electronic claims standard—a partnership between public and private health sectors to establish a more streamlined claims process.

The penetration of patient management systems in Canadian general practice was 57% in 2000, with only 12% of GPs using the full patient management functions and the rest simply using administrative capabilities.⁹⁵

This penetration level has almost certainly increased in the last 5 years and could be expected to be similar to Australia's, with similar opportunities and challenges for software developers.

With 450 health IT firms, the competitive environment in Canada is similar to Australia's, although the top 10 firms have a lower market share (25.6%) than in Australia, suggesting a somewhat more open market.⁹⁶

The expenditure in health IT infrastructure provides an opportunity for Australian health IT firms looking to export and Canada may provide a better opportunity than the UK. Different provinces manage their own e-health projects under the guidance

of the Canada Health Infoway and this decentralised approach allows smaller Australian firms to compete for more appropriately sized contracts and deal with customers who are more amenable to approaches from smaller firms.

Asia Pacific

The Asia Pacific is a diverse region, consisting of countries at very different levels of development, with different cultural backgrounds and national philosophies.

Malaysia

The level of competition in the Malaysian market is relatively low, with only approximately 110 health IT firms present.⁹⁷ However, the Malaysian health sector is becoming increasingly capable and sophisticated. Public health funding has increased in line with the growth in the economy, from RM 3.4 billion in 1996 to RM 7.6 billion in 2003⁹⁸—an average annual growth rate of 8.3%, and equivalent in 2003 to almost 7% of the national budget.

The public health sector in Malaysia is administered centrally by the Ministry of Health, which oversees public hospitals, specialist medical institutions, dentistry, state health departments, public health insurance and the pharmaceutical control bureau. There are 13 major public hospitals, with a capacity greater than 600.

The health sector has received significant emphasis in the 7th and 8th Malaysia Plans, with health being part of the Malaysian multimedia super corridor project.

The 9th Malaysia plan is yet to be announced, but it would be surprising if the health sector were neglected as the Deputy Minister of Health, Datuk Seri Dr Suleiman Mohamed, announced to the Malaysian Medical Association in June 2002 that health spending would be increased from 3.77% of GDP to 5%.

India

India's population is over 1 billion, and it is becoming an increasingly important force in international trade. Goldman Sachs predicted that India's economy could grow at a rate higher than 5% pa over the next 30 years, although its per capita income will still be low compared with the G6 nations (France, Germany, Italy, Japan, UK, US).⁹⁹

In 2001, India's per capita GDP was USD 1560 compared with Australia's USD 27,614.¹⁰⁰ India's health system is large, with over 100 000 doctors and approximately 16 000 hospitals.¹⁰¹ This compares to a total of 1297 hospitals in Australia. However, India's health system is still facing many challenges. Its per capita health spend is only three per cent of Australia's.

In 2002, McKinsey & Company forecast that the health care sector would grow by 13% pa, and noted that medical tourism had been growing at 15% pa having seen growth of 30% during 2000.¹⁰²

In June 2004, India's President announced that the government would raise its public health allocation from 0.9% to 2% of GDP over the next five years, but suggested that this increase would be spent on primary healthcare and disease

prevention strategies aimed at the poor, rather than focusing on the acute/curative services of the public hospitals. Hence, it is anticipated that India's public health sector will have relatively low expenditure per capita, and is unlikely to provide attractive opportunities to Australian health IT firms.

It is in India's private sector that the greatest opportunity may lie. Private health spending in India accounts for more than 80% of the total spend. The rapidly growing wealth of the middle class is fuelling the development of exclusive private health centres and private health insurance designed to service the wealthier segment of the market.

One of the most significant of the private hospitals groups is the Apollo Chain, which owns or operates 45 hospitals and is positioning itself as a provider of medical tourism, offering healthcare at costs one fifth to one tenth of those in the US or Europe.

It is also expanding beyond India, with facilities in Bangladesh, Sri-Lanka, Saudi Arabia and Africa. Besides medical tourism, Apollo is investing in telemedicine and has its own IT subsidiary, Apollo Health Street.

The significance of the growth in private health insurance should not be underestimated. This sector is reported to be growing at 23% pa, and it is being encouraged by government as a means of improving the sector without increased government funding.¹⁰³ This may provide opportunities for those Australian IT firms that specialise and have a track record in private sector health care systems.

New Zealand

New Zealand has a system of public and private health services similar to Australia's, with approximately 80% of health care being publicly funded.¹⁰⁴ The public system is divided into 21 district health boards, whose annual budgets vary from NZD 48 million to NZD 870 million. New Zealand is well advanced in its health information infrastructure. The use of computers by GPs is high, with 99% of GP practices using a patient management system and 94% of practices connecting to the health intranet.¹⁰⁵

New Zealand has in place a national health index with a unique personal identifier, something that Australia is attempting to achieve with the HealthConnect program. In 1996, The New Zealand Ministry of Health initiated a health intranet project that commenced rollout in 1999.

The Health Intranet service is provided by two organisations: Telecom New Zealand and Healthlink (owned by Orion Systems International, a New Zealand headquartered firm with a substantial presence in Australia). The health intranet offers secure, authenticated data transfer between health care providers.

New Zealand is also advanced in automated hospital procurement systems using a central e-commerce exchange. The Australian firm Pacific Commerce is playing a role in this initiative. Due to strong similarities and deep economic and cultural linkages, New Zealand is likely to remain an attractive market for Australian health IT firms.

New Zealand is certainly well advanced with its health IT infrastructure and its use of ICT at the GP level, and no new areas of focused government investment that might indicate a specific market opportunity have been revealed. Despite this, the strong similarities between Australian and New Zealand health systems and the deep cultural linkages, suggest that New Zealand overall is an attractive market for Australia Health IT firms to explore.

The e-health software market

The e-health vertical software market consists of a number of segments. In the following sections each is discussed briefly, leading to a consolidated mapping of the health software vertical market.

Clinical systems

Clinical information systems provide information to assist decisions based on the patient record and current symptoms. The patient record is expected to become increasingly sophisticated and may eventually hold a wide range of information about the patient, including genetic, environmental and social contexts.

It is the data contained within the patient record of clinical systems and other health IT software that allows the creation of a sharable EHR and is one of the pillars of e-health. Thus the benefits of acquiring interoperable clinical systems are experienced not just by the health provider, but across a broader health care system.

Health care organisations typically purchase clinical systems from the big, well-known vendors as a means of reducing risk. There is also a convergence of functionality provided by the large vendors, with increasing standardisation. Large vendors are also adopting a bundling strategy, offering a full suite of products and services with their systems (e.g. including monitors, lighting room design, redesigning the clinical process).¹⁰⁶

Competition in the global market includes a number of large firms, such as Siemens, GE Health Care, Cerner, McKesson, Perot Healthcare Systems, iSoft and Dinmar Inc.

Table 12. Australian firms in the clinical systems market segment

<i>Clinical systems</i>	
IBA Technologies	A local health care information systems provider with a comprehensive suite of clinical and administrative products. It will soon deliver its managed services technology to the South Manchester University NHS Trust and the Kettering NHS Trust (north of London)
Health Communications Network (HCN)	An Australian firm with over 80% share of the GP market for patient management software. It also develops complementary GP practice management software
Hatrix	Developers of medication management and medications decision support systems

Source: CIIER Analysis.

TrackHealth is a significant Australian player in this market. The Medtrack system has been selected for use by Queensland Health. Another significant Australian player is IBA Technologies, which appears to be undertaking a growth by acquisition strategy—acquiring several companies, including Monet Technologies in June 2005.

A licensing agreement which would transfer ownership of IBA's Clinical Systems, PAS Systems and Pharmacy System to Kodak in 2009 was reported to be 'under a cloud' at the time of writing this report, as aspects of the deal are renegotiated (See also ASX announcements 12/9/05).¹⁰⁷ Also, at the time of writing this report, an announcement as to which clinical systems vendors will be selected to be on Victoria's HealthSmart panel was pending.

Clinical support and other systems

Clinical support and other systems include pharmacy systems, pathology systems, radiology systems, medical imaging equipment and other systems, such as those used in the allied and community health areas (e.g. dietetics, speech pathology).

Providers of clinical support systems face clearly defined global markets.

Interoperability with core clinical and patient administration systems is a common demand, and adherence to standards such as HL7 for health record data and PACS for managing images is now a requirement. The advances in imaging equipment, such as 4D ultrasound, high speed MR and 16 Slice CT, are forcing radiology departments to manage hugely increased volumes of data.

This is resulting in demand for the imaging functions of PACS to be fully integrated with radiology information system (RIS) functions.¹⁰⁸ Although this is a relatively new market, Frost & Sullivan estimated the market for consolidated RIS/PACS products at \$500 million to \$784 million in 2004. Australian companies that develop systems with dependencies to imaging data without addressing the imperatives of PACS integration and image storage and retrieval will face declining opportunities.

Box 1. True Life Anatomy

True Life Anatomy (TLA) is an IT development company based in Adelaide, which has produced innovative desktop software which provides interactive access to real-time 3D images of a patient's injury at the bedside, in the clinic or in the operating theatre. TLA combines 3D animation tools, typically used for computer games applications, with conventional anatomical imaging (CT scans) to give a real time view of bones and surrounding tissues. For the first time, orthopaedic surgeons and other clinicians can view an injury and manipulate the image to accurately show a patient or a medical team what has happened and what is planned.

The unique advantage over competitors in the radiology 3D medical imaging market is the ability to export the TLA 3D models to clinicians. The images can be conveniently manipulated and viewed in real time which does not require specialised computer hardware or computer skills. This form of technology has established a benchmark for image distribution and is now being used clinically and, in the future, will allow true virtual surgery and 3D arthroplasty templating.

Source: DCITA (2005) *Secrets of Australian IT Innovation*, Department of Communications, Information Technology and the Arts, Canberra.

The market for pharmacy systems is significant, with the US market alone worth USD 1.4 billion in 2003.¹⁰⁹ There are quite a number of Australian developers of pharmacy systems, which may be a sign of maturity in this market. If so, consolidation might be expected.

Australian diagnostic service provider Sonic Healthcare developed its own web based radiology system in 2003,¹¹⁰ and such internally developed products are not unusual. Some Australian hospitals' IT departments have developed their own systems, especially in support of allied and community health needs and for capturing data needed by state governments for monitoring service levels.

This begs the question as to how well the existing products and specialist developers are addressing the needs of health service providers, but it does indicate that there may be additional market opportunities for packaged software in this area.

Table 13. Australian firms in the clinical support market segment

<i>Clinical Support and Other Systems</i>	
Kestral Computing	An Australian firm developing HL7 health message interchange software as well as offering radiology and pathology management systems
Pen Computer	An Australian firm developing health software for mobile hand held / pen devices, which has broadened its scope into several different clinical support systems and health status recording systems
TrakHealth	Australian developer of a suite of patient administration, clinical and clinical support modules designed for use in a Hospital or medical facility
Cosmos	Australian developer of software for dispensing and stock management for retail pharmacies
Amfac	Australian developer of retail and hospital pharmacy dispensing systems
Centaur Software Development Pty Ltd	Australian developer of dental practice management software
IntelliRad	Australian developer of tele-radiology, PACS, and medical imaging diagnostic workstation software
Medseed	Australian developer of decision support tools for clinicians and telemedicine applications
Integrated Medical Systems (IMS)	Developer of medical records, patient billing, laboratory management, occupational health and safety systems
Verdant Health	Developer of health applications for the community health sector

Source: CIIER Analysis.

There are a number of Australian firms operating in this space. Our analysis suggests that there is competition from the likes of McKesson in more established areas (e.g. pathology and imaging) where companies such as GE and Agfa are significant players, but less competition in such areas as community and allied health systems, which may be viewed by software developers as lower value markets.

Box 2. Repatriation General Hospital

Infection Control Enterprise (ICE) is an innovative health software package that collects information from other health systems, analyses it, and then provides decision support to the hospital to control infection. It offers cost-benefit savings to hospitals, and reduces risk and improves quality at the same time.

The Repatriation General Hospital in South Australia in which ICE was developed, is a 250 bed hospital for veterans and the general public, with a reputation for commitment to patient care. During the last ten years the Repatriation General Hospital has developed many products, including ICE.

The team at Repatriation General Hospital is in the process of commercialising the software to ensure that its benefits can be enjoyed internationally, and to apply the rewards back to the hospital community.

The team want to achieve a benchmark for infection control internationally and, to do so, ICE can provide the information to determine if a hospital is safe. This is a community service that adds value to patients and reduces hospital risk at the same time.

Source: DCITA (2005) *Secrets of Australian IT Innovation*, Department of Communications, Information Technology and the Arts, Canberra.

Medical devices

Medical devices can cover anything from simple tongue depressors and bedpans to complex programmable pacemakers with micro-chip technology and laser surgical devices.¹¹¹

The Australian medical devices market is worth more than USD 100 billion and is growing by 9% pa.¹¹² The US is the largest world market, and Europe the second largest. Asian markets for medical devices are growing rapidly. Australia manufactures medical devices worth approximately AUD 720 million, and exports approximately AUD 600 million. Of the total domestic medical device market, Australia manufactures 36% and imports 64%.¹¹³

Table 14. Australian firms in the medical devices market segment

<i>Medical devices</i>	
IM Medical Limited	An Australian investment vehicle for health sector technological investments, currently developing a web enabled heart function monitoring device
Compumedics	An Australian manufacturer of computer based patient monitoring and diagnostic systems with a focus of sleep diagnostics and neurology
Resmed	An Australian manufacturer of devices focused on the treatment of sleep disorders
Cochlear Ltd	Well known developer of the 'bionic ear' hearing implant. Although not strictly a software developer, their speech processor technology uses sophisticated embedded software within their devices
Ventracor	Australian manufactures of implantable heart device, with some associated remote device monitoring software

Source: CIIER Analysis.

An examination of the membership list of the Medical Industry Association of Australia (MIAA), the peak body for medial device manufacturers,¹¹⁴ suggests that there are few Australian owned IT/software companies participating in the medical devices industry.

Most companies using sophisticated software within their product are foreign owned, and most Australian companies manufacture items that do not contain a significant software component (e.g. artificial hips and non-stick syringes). Therefore, we have identified no more than a handful of Australian companies that have software development capability in this area.

Despite the overall attractiveness of the medical devices market, it does not seem to be providing a large opportunity for Australian software companies. However, industry, with support from the Department of Industry, Tourism and Resources, is currently developing an action agenda to support the Australian medical device industry, which may uncover further opportunities for Australian software developers.¹¹⁵

Box 3. Cochlear Limited

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

Cochlear operates in a global niche market with 80% share of the market in Asia-Pacific, 60% share in the Americas and approximately 60% share in Europe. Cochlear markets into 80 countries across the Americas, Europe and Asia, and continues to expand its export base throughout these regions and the Middle East. Cochlear employs over 800 people, 450 of them in Australia where the head office, manufacturing and the majority of R&D are located.

Dedication to innovation means Cochlear is a significant investor in R&D, with \$44.5 million spent on R&D in 2004—a 7% increase from the previous year. The research program provides significant opportunity for Cochlear to leverage the latest technology research for future products. Collaboration is also a critical part of the developing relationship between major implant professionals and Cochlear. 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.

Cochlear has been one of the major success stories on the Australian share market over the last five years, experiencing enormous growth in revenue and operating profits and providing substantial share returns. Sales revenue for the year ending June 2004 was \$282 million. Cochlear Limited is just outside Australia's top 100 companies, with a market capitalisation of over \$1.5 billion.

Source: PMSEIC (2005) *Growing Technology-Based SMEs*, Final Report March 2005, Canberra.

Patient administration systems

Patient administration systems (PAS) are commonly used in medium to large hospitals as stand alone systems. The role of these systems is to make patient bookings, allocate resources such as beds and equipment, schedule theatre bookings and manage patient service data.

These systems also coordinate the delivery of services to the patient, including meals, linen, equipment and disposable items. They are typically linked to finance, supply and administration systems to fully integrate the operation of the hospital and related community services.

Hence, PAS systems play a pivotal role in delivering e-health benefits, as they maintain the full patient demographic information vital for completing the basic record data in a shared EHR.

In Australia, there are several new initiatives to upgrade and integrate PAS across states and territories. PAS are a first priority for government funding, and contracts have already been let in NSW, Western Australia, South Australia, Tasmania and Northern Territory, with other jurisdictions expected to follow shortly.¹¹⁶

Integration of hospital PAS with GP and specialists and private sector health services (e.g. pathology, imaging, physiotherapy, etc.) for activities such as e-booking and e-prescribing, and mobile and wireless services for outpatients will be future steps on the development path for PAS.

NEHTA is facilitating the development of a nationally agreed record standard and a privacy protocol that will be used by all Australian jurisdictions. Pilot programs are being completed, and the solutions developed will be incorporated into PAS implementations.¹¹⁷

Table 15. Australian firms in the patient administration market segment

<i>Patient administration</i>	
Promedicus	Developers a range of health related products including practice management software, secure messaging and digital image handling (PACS)
IBA Technologies	A local health care information systems provider with a comprehensive suite of clinical and administrative products. It will soon deliver its managed services technology to the South Manchester University NHS Trust and the Kettering NHS Trust (north of London)
Health Communications Network (HCN)	An Australian firm with over 80% share of the GP market for patient management software. They also develop complementary GP practice management software
Integrated Medical Systems (IMS)	Developers of medical records, patient billing, laboratory management, occupational health and safety systems
Global Health	Developers of e-PAS a web based patient management system
Track Health	Australian developers of a suite of patient administration, clinical and clinical support modules designed for use in a Hospital or medical facility

Source: CIER Analysis.

Growth prospects in the PAS market remain good, as many legacy systems are not capable of supporting e-health developments. However, competition for the major public sector contracts in the Australian market has been strong. International firms have often won the major contracts, sometimes leading a consortium.¹¹⁸

Large foreign owned competitors in this market include McKesson (US), iSoft (UK), and Capula (UK). New foreign entrants include UK based H2Hcare, with a web based PAS system. Recent newspaper reports indicate that at least one Australian company, TrackHealth, is a serious contender for selection in Victoria's HealthSmart project, along with iSoft, to provide patient administration systems software.¹¹⁹

HCN has achieved more than 80% penetration of the Australian GP marketplace by pursuing a business model that provided the software to the GP for free or at very low cost.

As a result, their product, Medical Director, has become a *de facto* standard among Australian GPs, and companies wishing to provide services to GPs often integrate their offerings with Medical Director.

Finance, supply and administration

Software applications in this segment relate to patient invoicing, general ledger, procurement, stock control, casemix coding, coordination of outsourced services, etc. Products are commonly used by public and private sector service providers on a stand-alone basis.

As with PAS, the installed base in many health care providers needs to be upgraded to provide an integrated system. In addition, new products are being added to handle linkages for health insurance claims processing and pharmacy services.¹²⁰

Table 16. Australian firms in the finance, supply and administration market segment

<i>Finance, supply and administration</i>	
Pacific Commerce	An Australian firm specializing in improving the B2B procurement and supply chain within the health sector. They host electronic catalogues for suppliers such as Baxter, and the NSW government's SmartBuy procurement initiative and are currently operating this procurement solution in New Zealand, with seven district health boards and 28 health suppliers
ICS Global and Thelma	Thelma is an electronic transaction clearing house focused principally on the tracking, routing and monitoring of payments and claims between private hospital and health insurance firms. It is operated by ICS Global Pty Ltd
Centrex Technologies Pty Ltd	Operators and developers of web based linen inventory management and tracking service for hospitals
Jamsoft	Australian developers of billing software for health professionals
TC Health Admin	Developers of casemix medical records administration software

Source: CIIER Analysis.

Australian states have encouraged the implementation of a common ERP platform to ensure rapid reporting of financial information back to government. Contracts are

typically let to large multinational ERP suppliers. Both Victoria and NSW have chosen Oracle, while Queensland Health and Mayne Health also implemented SAP. Recently, various governments have sought to improve the efficiency of the procurement process. AHMAC created the Supply Chain Report Task Force, and NSW has implemented health procurement through its SmartBuy system. Such projects are likely to have implications within health care providers, and may, over time, force systems upgrades to enable participation. However, success with these programs seems to be constrained by the enormous complexity and effort involved in standards, implementation and subsequent integration (See 'Trade and commerce' chapter).

As the segment is dominated by foreign owned multinationals (e.g. Oracle, SAP, 3M, etc.) the opportunities for Australian companies lie in exploiting niches. A case in point is Centrex Technologies, which has developed a web based linen tracking and management system, which they appear to be successfully selling as a service in the US market.

Infrastructure

Products in the infrastructure market segment include such things as middleware capable of translating messages between various health message exchange standards and proprietary protocols, secure environments for sharing patient data or requesting clinical support services, and products for managing digital patient data including Electronic Health Records.

Aspects of this segment can be considered to overlap with the enterprise application integration (EAI) or middleware market and some multinational middleware providers, such as SeeBeyond, Oracle and Microsoft's Biztalk platform, incorporate HL7 messaging capability. In Australia, SeeBeyond is understood to have secured contracts with HealthConnect, which gives it an important advantage in competing for future HL7 integration projects that may arise.

Table 17. Australian firms in the infrastructure market segment

<i>Infrastructure</i>	
Smart Health	Australian developers and proponents of shared electronic health record technologies and supporting software
Medical Objects	An Australian firm involved in the development of HL7 messaging technology
Kestral Computing	An Australian firm developing HL7 health message interchange software as well as offering radiology and pathology management systems
Promedius	Developers a range of health related products including practice management software, secure messaging and digital image handling (PACS)

Source: CIIER Analysis.

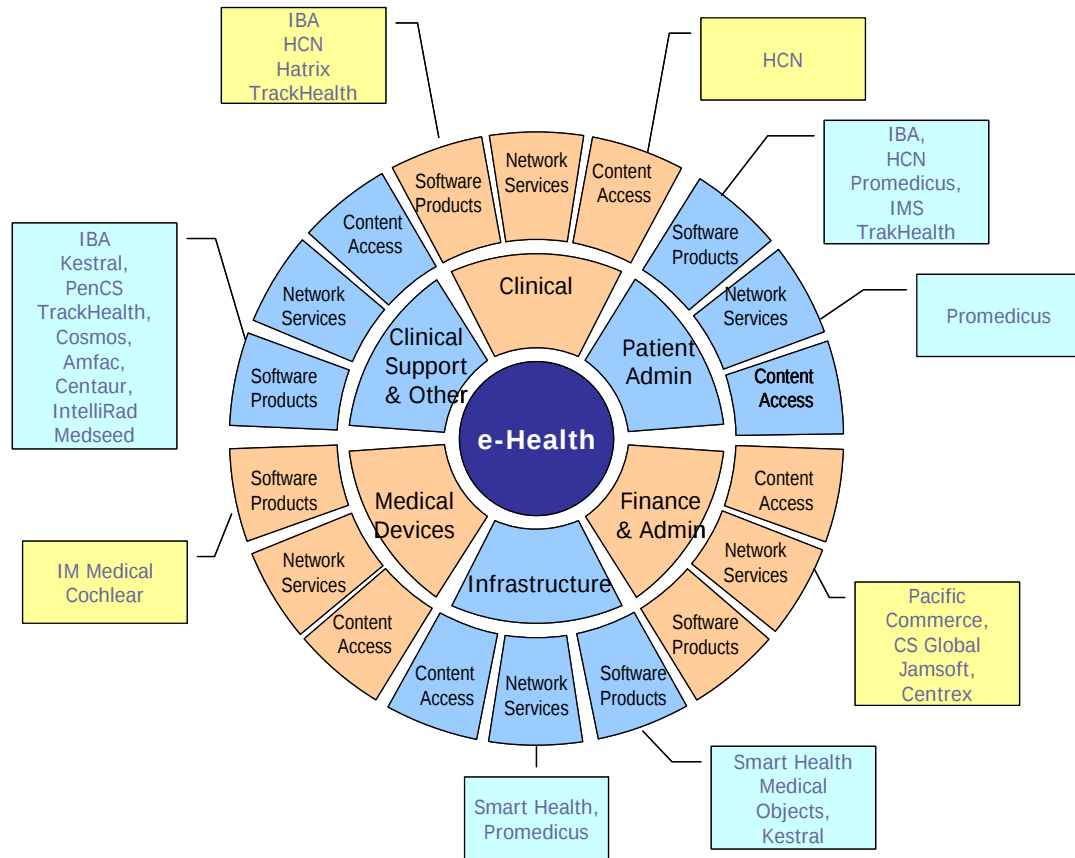
In discussions with one local provider of HL7 middleware, a comment was made that their product could do all that the foreign product could do, at one quarter the price, but governments and hospitals needed the security of buying the 'name brand'. Australian middleware producers wishing to compete against MNCs in the area of the newly emerging health standards will face a difficult road unless they can offer something unique.

An example is Australian company Promedius, which has developed a secure e-mail system for internet delivery of diagnostic results. This is akin to an EDI VAN for diagnostic results. Promedius claims that two thirds of GPs in Australia use their system, thus creating a *de facto* standard. Promedius is an example of a company that has stepped into a niche that is not completely standards dominated and quickly secured a relatively large market share.

E-health software suppliers

The e-health vertical software market map shows how these firms are distributed across the various market segments. This map does not identify all firms in the e-health vertical software market, it is merely indicative. It is intended to demonstrate where Australian activity is concentrated.

Figure 11. E-health vertical software market map



Source: CIIER Analysis.

Three firms are particularly noteworthy for their apparent dominance in their respective markets—HCN, Centrex Technologies and Promedicus. This seems to have been achieved through exploiting a niche or aggressively entering a market and obtaining market share quickly, so that they become the *de facto* standard.

IBA appears to have the resources to undertake a growth strategy by acquisition, purchasing several companies and gaining market entry to the UK and New Zealand, while simultaneously pushing into the GP marketplace in Australia. TrackHealth has also secured contracts in the UK, and has marketing relationships with the likes of Deloitte and Accenture in Brazil and Spain, and technology linkages with IBM, Intersystems Corporation and Symbol Technologies.

Electronic health record company SmartHealth has established a relationship with Telstra and with a Kuwaiti technology systems group, WLL.

Innovation base and support infrastructure

Although there are a significant number of formal linkages between universities, CRCs and other research bodies and Australian biotech companies, particularly those involved in genetic and drug research, our analysis suggests that most

Australian software companies rely on their own resources to undertake R&D and product development (See Part A).

Box 4. Diagnostics CRC

The Diagnostics CRC research program discovers novel diagnostic targets and develops both high affinity reagents and high-sensitivity reporter systems. This is achieved through five integrated and collaborative projects: protein profiling (for novel Biomarker identification), genome diagnostics (for SNP biomarkers), high-affinity reagents (both protein and peptide libraries) and a core focus on infectious diseases and high-sensitivity Reporter Systems.

The participants provide collaborative platform technologies (e.g. the discovery of novel biomarkers) through analysis of molecular interactions, genomics and proteomics together with selection of complementary high-affinity diagnostic reagents.

The Centre's outputs include the development of diagnostic platform technologies, with particular emphasis on innovation in 'point-of-care' diagnosis, molecular arrays and novel opportunities for flow cytometry and high-sensitivity signal generation and capture for rapid quantitative assays.

Source: CRC Website (<http://diagnosticscrc.org>).

There appear to be limited direct linkages between government funded research bodies and Australian health IT companies. The Centre for Health Informatics at UNSW, for example, lists no Australian health IT companies among its partners.¹²¹

Of the nine organisations involved with the ARC Centre for BioInformatics at the University of Queensland, there are no Australian software companies – although two of its partner organisations, Nucleics and Proteome Systems, offer software as an adjunct to their equipment for analysis of DNA and proteins.

However, the University of Wollongong's Health Informatics Research Centre does have a linkage with Pen Computer Systems, and the Distributed Systems Technology Centre (DSTC) has been involved in developing an Open Electronic Health Record, although the DSTC is now closing and the intended future of its intellectual property is not yet clear.¹²²

The majority of external linkages with publicly funded research bodies and universities (documented and available in the public domain) seem to be with multinationals. There are few apparent linkages with companies like IBA, TrakHealth and most of the other companies listed in this section.

However, there are software development activities and capabilities with application to health among players in the research support and innovation base. For example, the CRC for Sensor Signal & Information Processing's (CSSIP) recent project initiatives have included research on statistical pattern recognition techniques for identifying molecular panel assays for the purpose of classifying lung cancers, and the development of a virtual microscope.¹²³ CSSIP is scheduled to close at the end of 2005–6.

The Cooperative Research Centre for Cochlear Implant and Hearing Aid Innovation (CRC HEAR) is dedicated to developing new hearing prostheses and procedures to improve communication for hearing-impaired adults and children.

A CRC HEAR research team was the inaugural winner of the University of Melbourne Business School e-challenge in 2001, an achievement that has led to the establishment of Dynamic Hearing Pty Limited, a venture-capital backed spin-off company.

Dynamic Hearing's first product, the ADRO processing strategy, is hearing aid software that utilises the power of digital signal processors to automatically place output levels of a hearing aid into the audible and comfortable range of a hearing-impaired listener. CRC HEAR has also commercialised a number of products through HearWorks, including:

- SPEAR3—a body-worn digital speech processor with software and development tools suitable for unilateral or bilateral cochlear implant and/or hearing aid research;
- SoundShield—an acoustic shock protection device for users of telephone headsets, which is manufactured by Polaris Communications;
- NAL-NL1—software for prescription fitting of hearing aids that maximises speech intelligibility for hearing aid users; and
- CView—software for position analysis of cochlear implants using radiography.¹²⁴

Such examples demonstrate the existence of highly specialised health related software development capabilities and proven commercialisation pathways, although direct linkages to the Australian software industry and health IT firms seem limited.

Health market conclusions

A key opportunity for Australian health IT firms lies in taking advantage of rapid change and the growing sophistication in e-health in Australia. The Australian Government and state/territory government initiatives to reduce health costs provide Australian firms with an opportunity to participate in this emerging area in the most supportive marketplace they could have.

This is reinforced by the study of Frost and Sullivan on behalf of Intellect UK, which identified Australia as a priority target for UK firms.

The fundamental drivers of change will be the level of adoption by the Australian health sector of the emerging interoperability standards being promoted by the government (e.g. HL7) and the level of commitment to engaging in health informatics standards bodies around the world.

The greater the involvement by Australia in these bodies, the greater will be the profile and level of respect in which Australian health software will be held in foreign markets, and the greater will be the opportunities created by networking.

Table 18. Overall SWOT analysis for Australian health IT firms

Strengths	• A good concentration of clinical support system firms • Several firms with large market share and demonstrated excellence in GP practice management systems and clinical systems • Health messaging firms that can take advantage of interoperability opportunities
Weaknesses	• Australian presence in health IT bodies in South East Asia appears to be limited • Linkages with Australian publicly funded research institutions appear to be relatively few
Opportunities	• Excellent opportunities presented by the Australian government interoperability initiatives to develop world's best practice interoperable health IT • Canadian and New Zealand markets present similar characteristics and growth potential to Australian market
Threats	• Strong competition exists from foreign firms in the Australian market (e.g. iSoft, Cerner, etc.) • Growth by acquisition is a strategy being adopted by foreign rivals (e.g. iSoft) • Australian firms may soon find themselves under pressure from large rivals

Source: CIIER Analysis.

The recent moves in the US to reduce its health care costs through federally coordinated programs, suggests that the health IT models being promoted in Australia will have applicability in that market too, provided that standards are compatible.

The US market is large and the competition fierce. The Australian government, or AHMAC, might usefully develop linkages with the US Department of Human Services to explore what opportunities for exchanges of ideas and mutual assistance in the area of interoperability could occur. This could prove to have downstream benefits for Australian firms, through enhancing the Australian health IT reputation in that market.

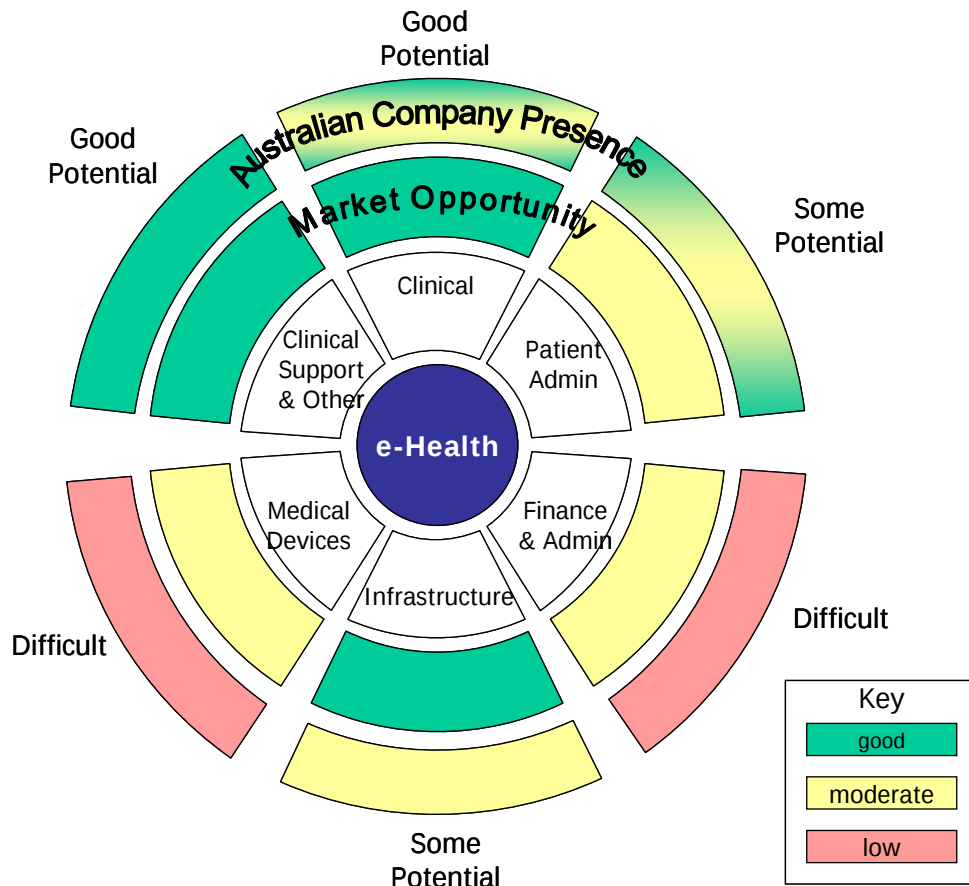
The Canadian and New Zealand markets are experiencing similar changes and developments to the Australian market. Australian firms that can demonstrate a successful product in their local market may find opportunities in the Canadian and New Zealand markets because of their similarity.

Competition is at equivalent levels to Australia in both markets. Some aspects of India's health sector appear attractive, including the relatively well financed private hospital chains and the private health insurance market.

It is likely, however, that the Indian market will be appealing to a relatively small number of Australian health IT firms. The UK is a highly desirable market, but with

significant competition. Successful entry requires substantial financial resources, and perhaps relationships with some of the prime contractors on the key projects.

Figure 12. Potential for Australian software in the e-health market



Source: CIIER Analysis.

From the perspective of the various market segments, the Australian software industry appears best placed to make its greatest gains in the areas of clinical support systems and clinical systems, with potential in patient administration and infrastructure.

Those concentrating on the GP market in Australia appear to have established barriers to entry for foreign competitors by obtaining large market share, thereby becoming the *de facto* standard. The situation in sophisticated hospital systems is quite different, with foreign MNCs proving to be tough competition, even in the domestic market.

It is likely that the level of sophistication of Australian producers will increase, driven by the intense focus by the Australian government on improving the interoperability of IT across the health sector. Those companies able to meet the demanding requirements of the current suite of e-health projects, as well as securing

contracts ahead of tough foreign competition, will be in a good position to compete in sophisticated overseas markets.

Information and communications technology

The software industry, and the ICT industry, produce a wide range of software products. These fall broadly into three groups.

- Enterprise products which have wide application and may also be addressed in a number of verticals
- Custom products that are designed for specific purposes that relate to specific vertical markets e.g. mine optimisation software
- IT systems ‘glue’ products: middleware, generic processing, security and generic interface software that encompass ICT business products (e.g. network management), web/internet management products (e.g. web tools and search engines), data management tools (e.g. data recovery and data integration), and software development products (e.g. languages, development engines and design tools)

The products identified in this ICT vertical are used in all industries and are not specific to just the ICT industry. Many of them are the tools used by ICT professionals to deliver ICT professional services.

Whilst operating systems and operating environment tools are included, that segment of the market is dominated by international suppliers and hardware vendors, with very limited prospects for Australian firms. Consequently we have not presented an analysis of the operating systems and operating environment tools segment.

The ICT software product system

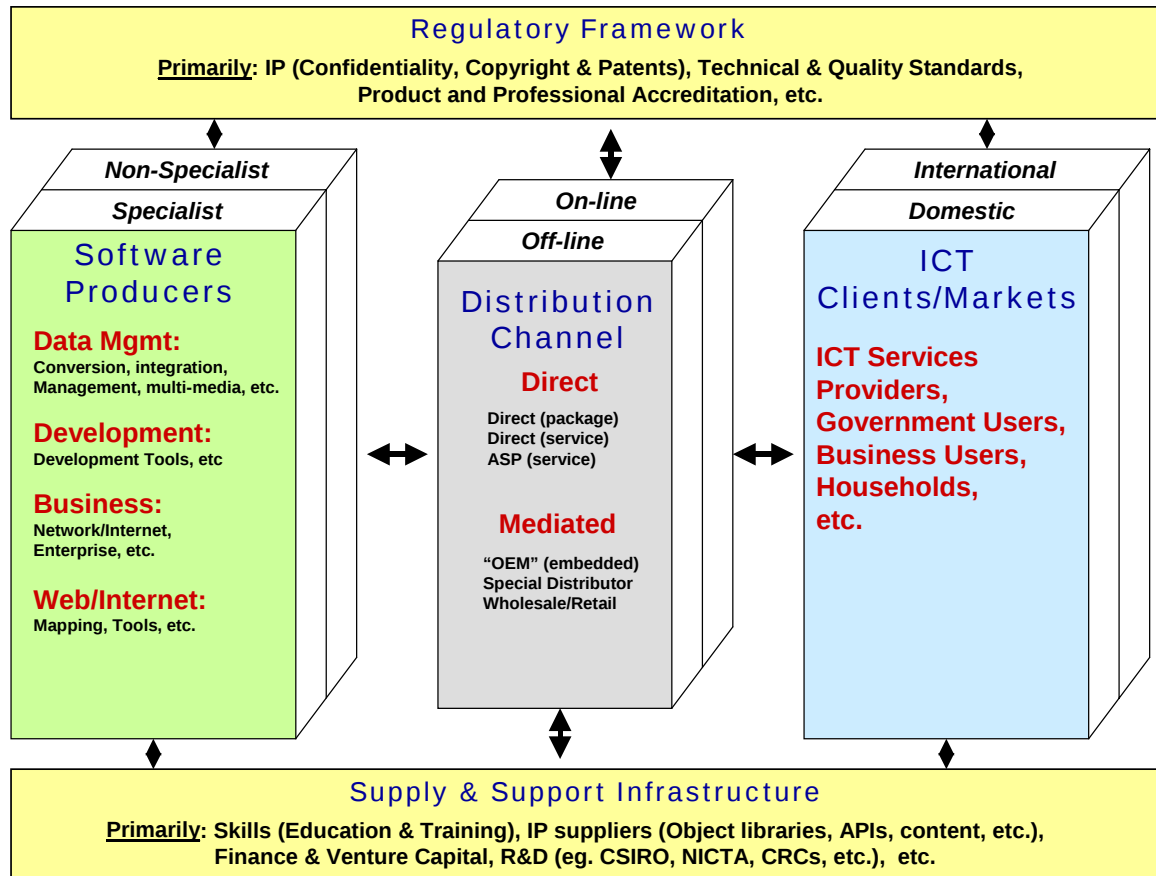
All the ICT product system is characterised by the dominance of the marketing power of global ICT players, e.g. IBM, which act as the major clients and the primary channel through which many software developers reach the market. As a result, the leading ICT services multinationals and, to a lesser extent, network equipment and communications services providers, are key gatekeepers to markets.

In more specialised segments (e.g. document management) of this vertical market there are greater opportunities for SMEs to deal directly with end-users, and thereby create a more direct path to market. In such segments, collaboration with clients and producer-client linkages are crucial for innovation and development.

As elsewhere, adherence to international standards and interoperability are crucial—especially in such areas as software e-security, content management and web tools where the need to be platform (operating environment) independent is crucial.

Product accreditation is also important, and a reference site can be an extremely useful way to gain credibility and instil confidence among would-be purchasers. As

one industry representative said: ‘In selling to overseas governments it is imperative to have a local government site as a reference, otherwise the product will not be considered.’¹²⁵



Source: CSES Analysis.

Software developers depend upon an ongoing stream of qualified people for development of new products. The required skill mix varies, with developers targeting the ICT vertical market likely to focus more upon the technical capabilities, while those in other verticals likely to seek a mix of vertical market-related business skills and technical skills.

For some time anecdotal evidence has indicated that some ICT employers believe that the higher education sector has a critical role to play in developing the technical and business skills required for ICT industries but that this training is typically not embedded in the science/technology degree, with students being required to make the connections between the technology and its commercial application and prospects. However some business IT degrees have added a work experience year to the normal three year course to ensure that graduates have some direct work experience in business.

Software markets

While there is no detailed breakdown of the ICT software markets available, our view is that software expenditure and some aspects of ICT expenditure can be used as indicators of the ICT vertical market growth since all ICT environments need and use many of the software products and tools produced for the ICT vertical market.

Global IT software spending in 2004 was USD 241 billion. Asia-Pacific region spending on software was USD 29.4 billion, 12% of the world total. Australia ranked 10th in the world as a market, with spending of USD 3.1 billion, and 3rd in the region behind Japan (USD 15 billion) and China (USD 3.9 billion). The US software market was worth USD 119 billion in 2004, almost 50% of the world total. The second largest world market was Germany with USD 18 billion.¹²⁶

Growth projections suggest that the gap between the US and the other leading markets (Germany in software and Japan in services) is widening. Forecasts for 2007 show US spending of USD 148 billion, compared to Germany's USD 24 billion for software, and USD 335 billion, compared to Japan's USD 88 billion for services.¹²⁷ By 2007, Australia is expected to rank 13th in software spending and 11th in services. In both software and services, China is expected to be the biggest mover, rising from 15th to eighth in software spending, and from 22nd to ninth services.¹²⁸

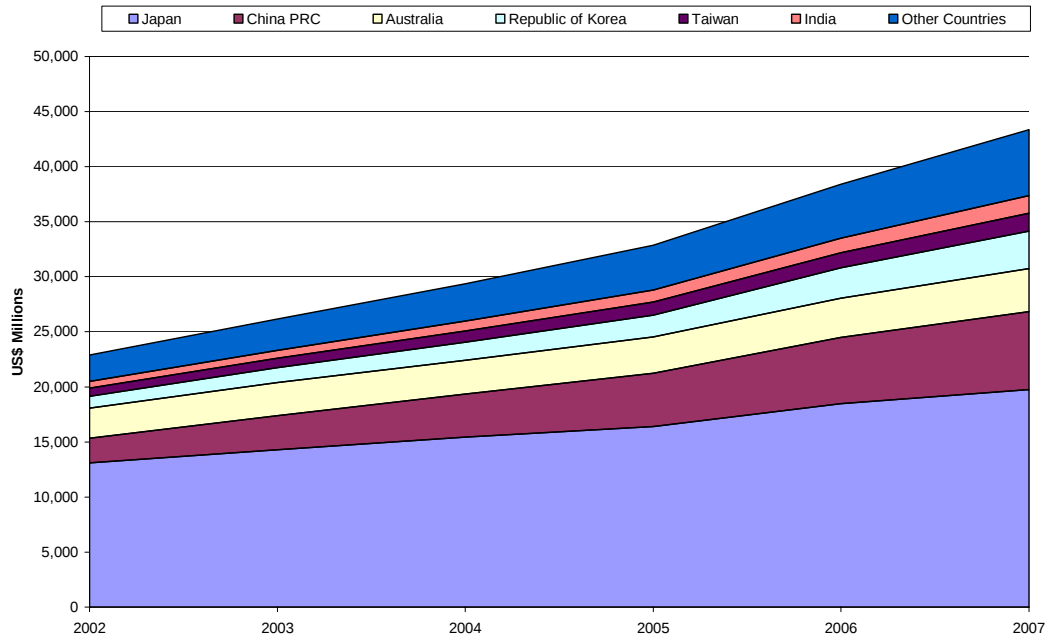
In 2004, Germany, United Kingdom, France, Italy and the Netherlands were the major markets in Western Europe, with software spending ranging from USD 18 billion to just over USD 5 billion.

Nevertheless, total spending of the five leading European countries was only USD 59 billion, compared to the US spending of USD 119 billion.¹²⁹ Projections for 2007 suggest that the same countries will continue to dominate Western European spending on both software and services.¹³⁰ In Eastern Europe, recent growth in software spending has been steady rather than spectacular, and figures released recently show spending in 2004 at USD 2.4 billion, rising to USD 3.5 billion in 2007.¹³¹

In the Asia-Pacific region there has been strong growth in software spending in a number of countries. Figure 13 provides software expenditure and some projections to 2007 for some countries in the Asia-Pacific region. Between 2000 and 2004, India's spending on software rose from USD 358 to USD 902 million, and it is projected to reach USD 1.6 billion in 2007.¹³² Despite offshoring to India being high on corporate agendas around the world, opportunities exist in India for Australian software firms focusing on vertical markets, such as health, transport, insurance, finance, chemicals and engineering.

In other countries in the region the opportunities are varied. In China, there are many opportunities for supply and cooperation, due to the rapid development of the ICT industry. Key areas include supply chain management (SCM), enterprise resource planning (ERP), and customer relationship management (CRM).¹³³

Figure 13. Asia-Pacific software spending, 2002–07



Source: WITSA. Digital Planet2004, The Global Information Economy

Note: The data for Figure 13 is provided in Annex 3.

Korea has developed a sophisticated manufacturing base for computer and telecommunications hardware and, with the rapid adoption of broadband, it has become one of the leading information economies in Asia. This has created opportunities for foreign firms that have internationally recognised technology and for services in a range of areas, including: Internet-related services, e-commerce applications, including payment solutions, network and systems integration services and smartcard and intelligent traffic systems.

Taiwan also presents opportunities for Australian exporters in such areas as e-commerce and digital content for e-commerce, e-security, e-government, e-learning, and intelligent transport systems.

Austrade's Global IT Team website has also identified opportunities for IT solutions in such areas as: advanced traffic management applications for urban networks; electronic tolling systems; smartcard systems for public transport; road and rail route planning and systems management; air traffic management; and advanced traveller information systems.

In Japan, there has been 'a rush for firms to plug security leaks' with 'technology solutions emerging as law takes effect' and the 'public demands data safety'.¹³⁴

This has created a business opportunity for ICT firms to help their clients prevent data loss. Another sector of the Japanese market that has grown rapidly is

authentication of online transactions. This market is driven by rapid growth of business-to-business e-commerce.¹³⁵

The big question facing Australian security software providers is, can they get access to this still growing market and do they have the financial infrastructure to support a foray into Japan?

Whilst the comments above relate to other market 'verticals' each of them also indicates a potential need for the 'tools of trade' (i.e. ICT software products), to assist in the building, monitoring and management of ICT environments.

Figure 13 shows the relative size and position of Australia vis-à-vis other countries in the Asia-Pacific region. Although Japan is the biggest market, its growth is slower, whereas the growth curves for India and China are steeper. While Indian software spending is relatively small compared with the top four countries, it may represent one of the best opportunities for Australian software suppliers.

However, the Chinese market is growing the fastest, and notwithstanding cultural and language difficulties, there is export potential for Australian software developers.

The challenge for Australian software providers is to gain access to the rapidly expanding markets of the Asia-Pacific region as well as global markets. Whilst a range of factors will clearly influence their opportunity, the proportion of SMEs, and thus the capacity to maintain an export effort, is seen as a significant hurdle. In response to the question 'Your corporate weakness?' one case study respondent replied:

If we have a weakness it is size. At times we have noticed that the size of our firm has affected decision making by potential customers. There is, at times, the syndrome of: 'if it is big it must be good' and if not 'they are big enough to sue.' Our biggest impediment to growth is the growing number of competitors and the size of some of our competitors. This requires our firm to become more innovative and clever.¹³⁶

The rising use of open source software is providing some niche opportunities for smaller firms to bring new products to market, and the Internet is also giving rise to new product opportunities.

Medium sized businesses and many smaller businesses are increasing the sophistication of their IT systems. The increasing use of Internet for commerce is driving the demand for integrated, robust and secure software systems on which to operate the trade and commerce products. There is also greater scope and demand for SMEs to integrate their operational and back-room activities.

In larger firms the use of web services and the move toward service-oriented architecture may also provide opportunities for smaller software suppliers.

Australian ICT software suppliers

The suppliers in the ICT software product industry comprise a wide range of organisations and vertical streams which sit across both vertical and horizontal business markets. A large portion of organisations in a vertical business market segment are serviced by multinational firms supplying overseas developed software (e.g. IBM and EDS). This is often done in conjunction with local service firms specialising in systems implementation and integration.

Funding for product development is one of the more significant differences between the US and Australian ICT sectors. 'In the US, angel funding is greater than venture capital funding, making start-up and research dollars more accessible. As a result, ICT firms in the US are able to get their product to market quicker and without the pressures venture capitalists place on the entrepreneur,' said one Melbourne focus group participant.¹³⁷ Another Melbourne focus group participant said:

Australia is seen to be competitive in price, even cheaper than Singapore and the US. Nevertheless, there are impediments to successfully entering the US market. Capital and lack of local market size prevent local firms obtaining critical mass and a revenue base locally that can support a US market attack.

One of the outcomes of these differences is that Australian SMEs developing software products similar to US SMEs, find it difficult to succeed at this level of the market because they lack critical mass and capital. While they are successful in the local marketplace, in many cases they do not have a scaleable product or sufficient capital to step into overseas markets.

As a consequence, the products are often not readily marketable overseas, nor is there a desire to go offshore. Hence, their growth is aligned with the growth of the business sector in which they operate.

On the other hand, the universal acceptance of ICT on the desktop, and the expansion of the Web and the Internet, has created new and diverse markets for specialist software developers. The expectation of the desktop user that all his/her data will be somehow managed and manageable is a key driver of growth of new product in the areas of data integration, security, document management, content management and search. These products can be classified under the heading of 'productivity tools'. They include:

- integration programs, which allow data from disparate systems to be integrated into one database or a single report. These are key to the presentation of 'legacy systems' data combined with the current applications' information;
- IT project and portfolio management for guiding the management of IT product and systems development and maintaining and upgrading installed IT systems. Products manage a range of functions from scheduling and tracking, resource

profiling and allocation, risk management, quality management, time reporting and governance;

- security systems, which manage user activity and accessibility on in-house networks, while detecting outside or illegal intrusion;
- document management, which manages electronic documents and records from creation, to archiving, to destruction across local or geographically dispersed operations and locations;
- enterprise content management, software solutions for the management of unstructured data;
- corporate compliance, which manages all aspects relating to a board of directors and addresses Sarbanes-Oxley legislation, CLERP9, BASEL II, etc. compliance issues;
- intelligent mapping applications, provides analytic capability between mapping and business dashboards (e.g. highly specialised software that analyses data between mapping applications and interactive business dashboards without the user having to write any further code);
- development tools, including business process analysis tools, object-oriented analysis and design tools, business activity monitoring tools, business rule engines, business process management workflow engines, integrated, model-driven code generators, fourth-generation languages, Java 2 Platform, Enterprise Edition (@JEE) and .NET integrated service environments;
- data mining, which provides the ability to retrieve and analyse large amounts of data from large databases / data warehouses without impacting the performance of the systems creating the data;
- multimedia and games, which can be seen as productivity and development tools for the entertainment sector; and
- data and resource tracking, which includes tools that allow comprehensive track and trace capability.

Australia has a number of organisations developing leading-edge software that fall into these categories.

MNCs (e.g. Microsoft) have the capability to develop the type of product discussed above, and frequently do, though there appears to be a growing tendency for these companies to buy specialist developers and incorporate their product or services into their portfolio.

The market for some products (operating systems) is overwhelmingly dominated by MNCs. While the MNCs previously focussed on large companies, they are now increasingly looking to sell to smaller businesses.

The proportion of Australian businesses using information technology continues to increase. Computer use has grown steadily, from 49% of employing businesses in

1993–94 to 85% in 2003–04. Internet use has grown more rapidly, from 29% of employing businesses in 1997–98 to 74% in 2003–04.¹³⁸

The market is driven by a number of factors. Upgrading functionality, improving integration with other software products, reducing cost per user and having good scalability to different sized systems and users are important. When new businesses are created, either by takeover, amalgamation or start-ups, software developers may expect a corresponding growth in their market as businesses are driven to use productivity tools to be competitive. For example, a new company of, say, 50 people would need 50 copies of a product such as Eracom security and a lesser number of others such as a network management tool.

Those firms developing ‘productivity tools’ (e.g. data management, web/internet tools) may have significant opportunities. Data integration tools are essential for the management of greater volumes of, and more disparate, data. The cost of replacing several older databases is considerable, thus software that allows data from different sources to be gathered and reported is a cost effective alternative.

A common focus for data integration is the integration of all data related to customers. These software products are sometimes called customer data integration hubs. The products support the global identification, linking and synchronisation of customer information from several sources, create and manage a central data base and enable the delivery of a single customer view.

Whilst web-based products are sometimes treated separately, data management encompasses the following.

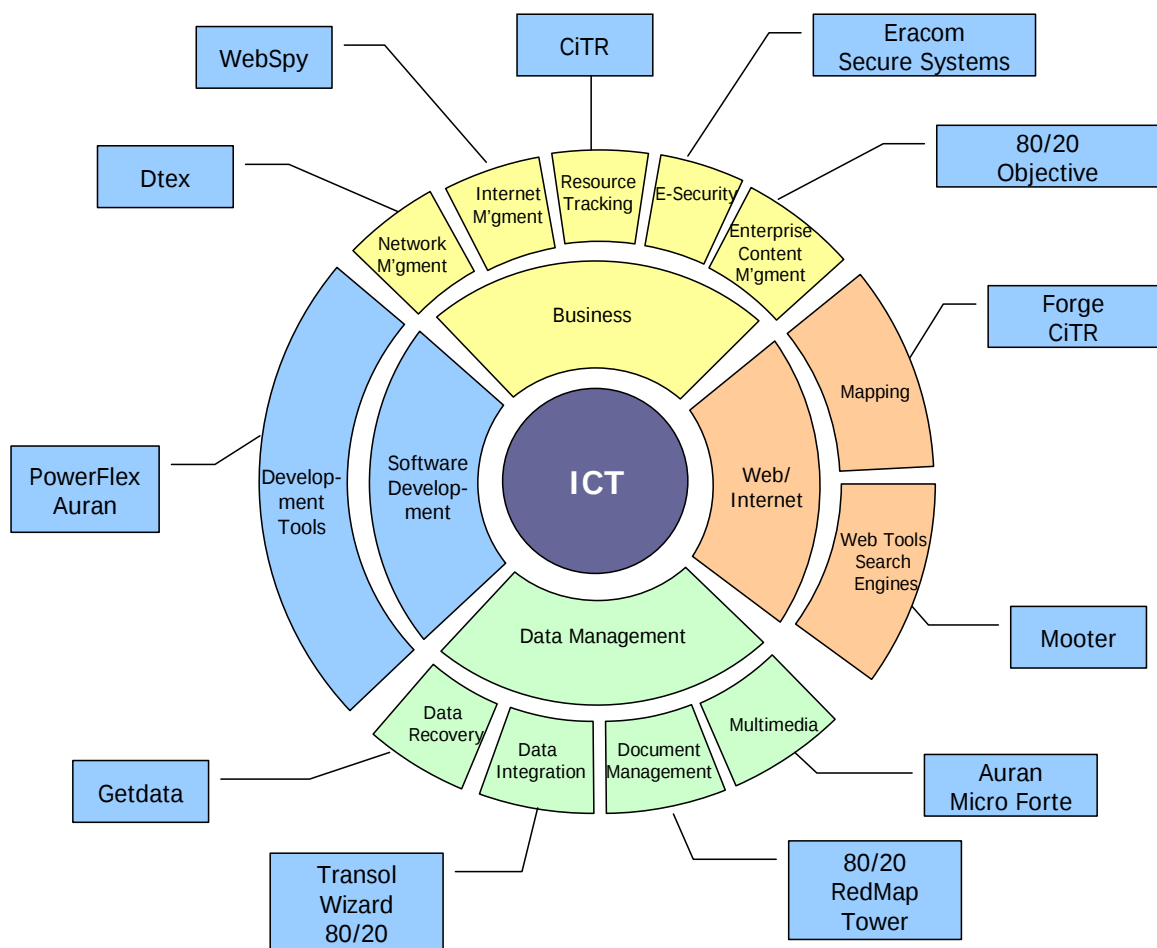
- Document management
- Web content management
- Records management
- Document capture and document imaging
- Document-centric collaboration
- Workflow to support business processes and routing content, assigning work tasks and creating audit trails

Overall, the growth in demand for the products from these sectors, particularly data tools, is driven by the overall growth of the economy. The size of the market for the majority of the products is driven by the end-user. However, some sectors are more influenced by the opportunities that developments in networking and the internet technologies allow (eg for media, logistics and finance). There is little research data available to quantify this potential growth in sales volume for an SME with a leading-edge product.

The product life-cycles for all software tools (due to the competitive nature of the ICT industry) can be short and this presents both dangers and opportunities. A market leader can be overtaken by the competition very quickly. For example, one Melbourne based firm developed a document management product in 1997, took it

to the local market (successfully) and then to the US, where it was an immediate success. Today, eight years later, the product is still being enhanced, but that marketplace is now full of competitors and the firm has developed a new product that has enabled it to move its primary focus to another vertical market.

Figure 14. ICT vertical software market map



Source: CIIER Analysis

With the rapid growth of Internet based sales new products are being developed to provide, for example, search and retrieval capability, content management, online ordering and information dissemination that are effective, efficient and easy to use given that the end-user is the public. This type of product has great potential early to market developers. A Sydney based online search engine developer has launched

a contextual advertising solution, which enables online publishers to provide targeted advertising aligned with their content.

Of the 84 000 businesses estimated to be receiving income from sales via the Internet in 2003–04, 28% generated less than 1% of their total income in this manner. A further 28% generated between 1% and 5% of their total income via the Internet, while 44% of businesses generated at least 5% of their total income via the Internet. Only 6 to 7% of these businesses generated 50% or more of their total income from sales via the Internet.¹³⁹

As business usage of Internet services increases it is not hard to see from this data that a large number of businesses are potential client users of products that support and improve these facilities.¹⁴⁰

Multimedia is another growing market sector that covers many different industries, ranging from broadcasting through games, music, film production to advertising. It covers both content and delivery mechanisms. The Australian multimedia industry is recognised for its technical strength in multimedia production. Within the ‘multimedia’ segment, the local games sector has been highly regarded for a decade, and attracts some of the most talented ICT people. A number of local firms are already actively exporting in these market segments.

Australian firms also figure prominently in e-security. E-security encompasses protection of data, data sources and data transport. Australian firms working in this arena have considerable expertise in access control systems, data encryption, virus protection, disaster management and data recovery. Due to the pioneering efforts of local firms in the areas of defence and intelligence networks, the Australian industry is rated highly around the world.

Some Australian firms operating in each of these market segments are listed in the accompanying table. Of these, the ones marked with ‘**’ are already exporting their products to markets that include the US, Eastern Europe and the Asia-Pacific region. This list is indicative, and by no means complete.

Table 20. Some ICT vertical market firms and products

<i>E-security</i>	
Biometix	Develops automated border control systems, and has integrated Cognitec's biometric facial recognition system into 'Smart Gate' a best-of-breed application. The system has been deployed by the Australian Customs Service, is under evaluation by the US government and is being used as a test case by the International Civil Aviation Organisation.
Eracom Technologies	A key player in the IT security industry for more than twenty years, Eracom Technologies has been a leading developer and global supplier of cryptographic based IT security products and solutions. As an industry pioneer, Eracom has developed cryptographic technologies which are internationally recognised.
Rocksoft	Develops high-performance, scalable, mission-critical data integrity, data management and security infrastructure software.
Secure Systems Ltd	Established in 2000, Secure Systems is engaged in the research and development of data security technology and applications for computer based data security. The Company develops security solutions to ensure confidentiality, data integrity and user authentication. Secure Systems has a wholly owned subsidiary in the USA which was established in November 2001.
Tenix Datagate	Develops and produces cutting edge network separation security used worldwide.
<i>Content management (including compliance)</i>	
80-20 Software Pty Ltd **	Founded in 1997 and with offices in the US and Europe, 80-20 Software specialises in solutions that empower corporations with effective governance through solutions that deliver real-time compliance, control and transparency. In 2000, 80-20 delivered its first solutions for use by boards of directors in delivering sound corporate governance.
Objective Corporation **	Founded in Australia in 1987, Objective has provided Government and Top 1000 Corporations with solutions that deliver maximum return on their information assets. Objective is now a global company delivering solutions throughout Asia Pacific, Europe and the Americas.

Mapping

Integeo	Integeo, a Forge Group company, develops and markets Map Intelligence, a spatial Business Intelligence product that creates information-rich, interactive maps "on the fly" from the contents of digital dashboards or spreadsheets with no programming required. Seamless switching between location and data views enables new insights into knowledge that is hidden behind your data. Map Intelligence facilitates state of the art decision-making; thus lowering risk, enabling better governance, improving productivity and lowering costs across your organization. Map Intelligence currently interfaces to mapping applications from the leading GIS vendors.
CiTR Pty Ltd **	CiTR accesspoint is a platform for the creation of service directories and information & knowledge management portals providing electronic business solutions for the Internet, telecommunications, enterprise and government markets.

Web tools (including search engines)

Mooter	Mooter Search is the leading provider of intelligent clustering, search and media personalisation software. Mooter has pioneered search result clustering and now provides a visually intuitive way to navigate through confusing amounts of data.
ISYS Search Software	ISYS Search Software is a global supplier of enterprise search solutions for desktops, networks, websites and intranets. The company's award-winning software has been implemented by organisations operating in a variety of industries, including government, legal and law enforcement.
P@noptic	P@anoptic is a highly effective search engine for the intranet, portal, websites or shared file systems. The search engine is oriented towards corporate and government intranets and portals but can be used in almost any search application. It supports all common metadata formats and can be customised to meet the needs of an organisation. The engine is used in major organisation is Australia and overseas.

Multimedia

Auran Pty Ltd	Established in 1995, Auran is one of Australia's oldest and largest game studios. Auran first came to prominence with the hit RTS 'Dark Reign: The Future of War', which won Strategy Game of the Year in 1997.
Krome Studios	Australia's largest developer, Krome Studios, has created a game that is uniquely Australian. <i>TY the Tasmanian Tiger</i> is a highly successful title selling over a million copies internationally. After this success, the publisher, Electronic Arts, is asking for more TY and the third TY game is currently in production.

Micro Forté	Micro Forté is one of the world's oldest development studios and emerging publisher of wireless interactive entertainment products. Micro Forté enjoys a strong leadership position in the Australian games industry, having founded the Academy of Interactive Entertainment Ltd. Through its two studios Micro Forté develops innovative, quality technology and computer games.
Torus	Torus has demonstrated the prowess of their Southpaw first-person shooter (FPS) Game Boy Advance engine when they developed <i>Duke Nukem Advance</i> , <i>Doom II</i> and <i>The Recruit</i> for Take Two, Activision and BAM! Nokia recently published the Torus developed <i>Ashen</i> , the first multiplayer first person shooter for the N-gage system. These games have gained international recognition for Torus as world-leaders in the genre.

Document management	
80-20 Software Pty Ltd **	Founded in 1997 and headquartered in Melbourne 80-20 created their core document and records management technologies. This product is still being sold through their offices in the US and Europe.
DocBanq Pty Ltd	DocBanq is a standards-compliant electronic document and records management system that is suitable for a wide range of organisations, including those in the biotechnology, public-sector, legal, engineering and financial services areas. DocBanq allows organisations to achieve records management compliance, where required, and to improve operational outcomes by allowing the secure sharing and searching of documents by all personnel.
Redmap Networks Pty Ltd **	Well established in the imaging and Information Management markets for over 12 years, Redmap sells predominantly through a growing network of Business (Channel) Partners throughout Australia, Asia Pacific, the United States and Europe. Redmap is acknowledged as a leading developer of document capture, document management and Information Management software.
Tower Software **	Tower Systems started in 1981 with an accounting system for Newsagents. In 1997, the first EDI (Electronic Data Interchange) trials were conducted linking the software to external supplier systems and in 1998 the first Windows point of sale program was released.
Weblogics	Weblogics has developed award winning web based knowledge management software solution, Intralogic. The product provides intranets, portals, internets and extranet knowledge sites that allow organisations to capture, manage and share their collective information and knowledge assets. The solution is very intuitive, out-of-the-box and requires no development or technical skills. Weblogics has a 14 year track record of success and customer satisfaction.
Data integration	
Transol Corporation	Transport Solutions Pty Ltd was formed some 10 years ago, to provide a highly specialised transport service with a complete distribution service from receiving imported product through to specialised delivery to customers.
Wizard Information Services Pty Ltd **	Wizard is Australian owned and operated, and has been providing IT solutions and services to both government and the private sector in Australia, Asia, Europe and North America since 1985. It has an outstanding reputation for providing quality products and services.

Data recovery

GetData Software	GetData Software specialises in data recovery and Windows system utilities. GetData's award winning data recovery software, allows recovery of files lost by accidental deletion, a software crash, virus infection or the accidental format of a hard drive.
------------------	---

Data mining

Prometheus Information	Prometheus Information is an organisation focused on delivering industry-specific business intelligence solutions. These solutions are built on our advanced, next-generation Business Intelligence technology. Prometheus BI empowers management to draw business insight from corporate data assets for timely and effective decision making. It has an unparalleled ability to add value to data through its capacity to: • express complex business logic • link data from disparate sources • apply algorithms across the full range of data • add information through extensive classification systems • perform meaningful statistical analysis • empower users to explore the data through tables, maps and graphs in an Integrated Analysis Environment
Forge data solutions	Forge was established in 1995 and has grown to be a successful, open-standards software development and consulting organisation, specialising in distributed systems (Enterprise Service Management), large-scale data management and security. Forge delivers solutions to major Australian and International clients.

Development tools

Powerflex Pty Ltd	POWERflex Corporation is the developer and manufacturer of PFXplus, a high-performance multi-user software product for application development which is used to create commercial-quality network business applications for Windows, Linux, UnixWare, Unix SCO OpenServer and AIX systems.
Auran Pty Ltd	Auran is currently producing V2.0 of its advanced 3D game development engine, Auran Jet.
Sparx Systems	Sparx Systems was formed in 1997 and specialises in the development of high quality modelling tools. Enterprise Architect is a UML 2.0 based modelling CASE tool and offers high-end features and performance at a price that the entire team can be outfitted, thus realizing the true potential of a collaborative and shared modelling environment.

Network management

Dtex Systems Pty Ltd
**

The Dtex Systems Group started in Adelaide in early 2000. Dtex is now a leading authority in internal security and is dedicated to becoming the pre-eminent provider of internal security solutions worldwide, with key strengths in the Asia Pacific market. Dtex officially launched the 'SystemSkan' product set in October 2002. Dtex has now set up its head office in Kuala Lumpur, which will be the centre for sales and marketing coordination throughout the Asia Pacific region, and will also house a new R&D centre.

Internet management

WebSpy Pty Ltd

WebSpy Ltd is a leading provider of Internet and e-mail Monitoring, Analysis and Reporting Solutions, all designed to provide meaningful reports and facilitate a transparent view of how network and systems resources are being utilised. Established for 10 years, with product representation in over 50 countries, WebSpy solutions are used by more than 6000 customers worldwide. WebSpy offices are located to provide comprehensive 24x7 support and customer services across Europe, Asia Pacific and United States.

Resource tracking

CiTR Pty Ltd

The latest product provides the capability of tracking all of a company's resources via an integrated track and trace system.

Source: CIIER Analysis.

Innovation base and support infrastructure

The generic ICT industry and its supporting infrastructure is examined in more detail in Part A of this report.

The key elements of innovation for the software industry sector are, as indicated in Part A, access to capital, communications capability and a supportive taxation and business environment (e.g. intellectual property protection). The information industry faces unique problems in relation to gaining access to finance such access to capital has been a perennial problem for software firms. These relate to the high level of R&D spending necessary for firms to stay competitive; and the lack of physical assets in activities such as software development; and the problems of placing a value on the intellectual property contained in the finished product.

The Australian capital market suffers from its small size, despite the extent of deregulation which has taken place. It therefore finds difficulty in dealing with the unique financing problems of the information industry in particular the software development segment.

Communications capability, especially high levels of band-width and reliability, is very important to software developers however low levels of adoption of broadband in Australia can adversely affect local software industry development

In the private sector, those SMEs that do significant R&D often spend up to 20% of their annual revenues. This group tends to be at the top end of the SME scale in terms of personnel size and revenues.¹⁴¹

Developers might benefit from greater engagement with and access to Australia's underlying R&D infrastructure, drawing on NICTA, CSIRO and various CRCs that focus their work on the relevant technologies, applications and vertical market. For example the CSIRO Business intelligence Group has excellent expertise in data mining and the Smart Internet CRC in Internet related technologies and applications.

In addition to the issues raised above there are a range of other regulatory issues affecting software firms addressing the ICT market. These include:

- privacy legislation and the need to build compliance mechanisms into development;
- professional indemnity and liability, an area in which recent developments have adversely affected SMEs in many industries;
- technical and professional accreditation, including a range of compliance and accreditation issues; and
- technical and quality standards

ICT market conclusions

We consider that the ICT vertical market sector offers good opportunities to organisations that have developed software products able to fill a niche market – particularly for tools. Unlike the application software market, where the large MNCs play a dominant role, the software tools market is more accessible to smaller firms—as the large MNCs tend to focus on the high cost, high profile projects for large corporates (using overseas developed software products).

There are a number of leading-edge software products that have the capability to position their Australian developer at the top end of the global market niche. In fact, a number of firms have already achieved this status. Nevertheless, we consider that there is still an untapped local market within smaller firms for software that operates across the spectrum of business requirements, and at the same time is independent of hardware platform and operating environment.

Very small businesses (those with fewer than five employees) had much lower adoption of information technology at June 2004, with 80% using a computer, 67% having Internet access, but only 16% having a web site or home page.¹⁴²

If the potential of the Internet was first seen and exploited by the developed world, the period between 2002 and 2004 marked the emergence of the developing world into the policies and politics of the Internet, driven both by their firms and

governments. The growth of the Internet provides the means for a new competitive opportunity for developers of niche software products, through the use of internet based marketing and distribution. This opportunity enables new and existing products to be available to a wider market in a shorter timeframe.

The alternative is a locally based branch office which has its own set of problems.¹⁴³ The relative ease of bringing a product to market and the ability to gain penetration (using technology to deliver the product) means that high cost distribution channels are not always necessary. However, it is also recognised that major players (e.g. Microsoft) use highly developed distribution channels very effectively.

Focus group attendees have suggested that almost all Australian ICT firms planning to export view the US as the ultimate marketplace. One view is that being a niche player in a large field can be more rewarding than being a big player in a niche field. One participant at the Sydney focus group meeting said: 'The US (marketplace) is huge, so any niche is okay.'

The experience of firms that have been successful in the export arena, however, shows how difficult it can be to gain a foothold in overseas markets where significant competition already exists. For this reason, the developing countries of the world may provide an environment where opportunities still exist and are open to all comers.

The WITSA report Digital Planet 2004 predicts that the services and software segments of the ICT market in developing countries will grow fastest over the next four years and thus offer the best opportunities, because of the lower investment required for equipment and infrastructure.

However, one needs to look at these markets carefully. In Africa, for example, while current spending on software is low, there are enormous economic issues facing individual countries which are likely to constrain the growth of ICT markets. The Middle East has some areas of greater wealth and market potential, but we consider that economic and other issues appear to be weighted against this region becoming a major export market for ICT products in the short term. Opportunities do exist in these areas, but probably not in sufficient volume to warrant an aggressive marketing campaign from Australia in this particular vertical market.

Similarly, Eastern Europe is a region showing growth and some potential, but there are language and cultural issues facing an exporter. Nevertheless, some Eastern European countries are becoming active in ICT manufacturing and in areas such as offshoring, which would suggest that the language barrier is not insurmountable. Moreover, some Eastern European countries have high levels of e-commerce and Internet use, which suggests that there may be some scope for Australian software exports of ICT development and management products.

We believe that there would seem to be good opportunities for ICT software products in the regions closer to home (i.e. the Asia-Pacific), especially in growing economies. This potential applies to most ICT vertical market software products, except software development languages, where there is the strongest market

presence of MNCs. Other products (e.g. web tools, data integration and data management) would seem to have the capacity to compete alongside other country's products.

Export market opportunities

Export potential was assessed for each of the vertical software market sub-sectors, and a ranking was allocated to each of the major international regions for comparison purposes.

This ranking is indicative and provides an approximate ordering of the regional opportunities for Australian firms, both for the vertical market in particular, and to a lesser degree, for software products in general.

Regions were categorised for Australian software of each sub-sectoral type as being a well established market, a strong potential market, or a less advantageous market, based upon the analysis in this Report.

A ranking value from 0 to 4 was then allocated to this market determination by sub-sector and region, to allow for graphic representation of the export potential.

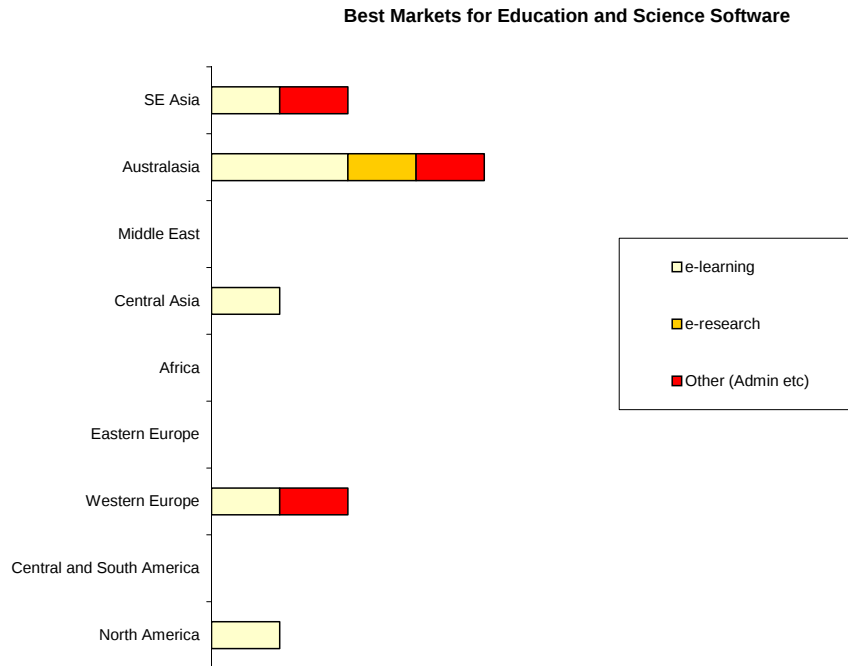
Ranking was allocated to each regional area, with a higher value for established markets, middle value for potential markets, and a zero value for less advantageous markets.

It should be noted that the relative size of the regional market for each vertical sub-sector varies considerably, and this would also need to be considered by individual firms. Nevertheless, the application of this ranking allows some comparison to be made of the relative significance and potential of particular target regions and for particular software sectors.

In some cases (e.g. mining software into Canada, rather than US, and educational software into UK, rather than France or Germany), the significance of a particular region is mainly ascribable to one particular country, rather than necessarily to the region as a whole. In order to maintain consistency between the vertical market sector graphs and allow for aggregation, all regions are shown in each vertical market graph, whether that region is referenced or not.

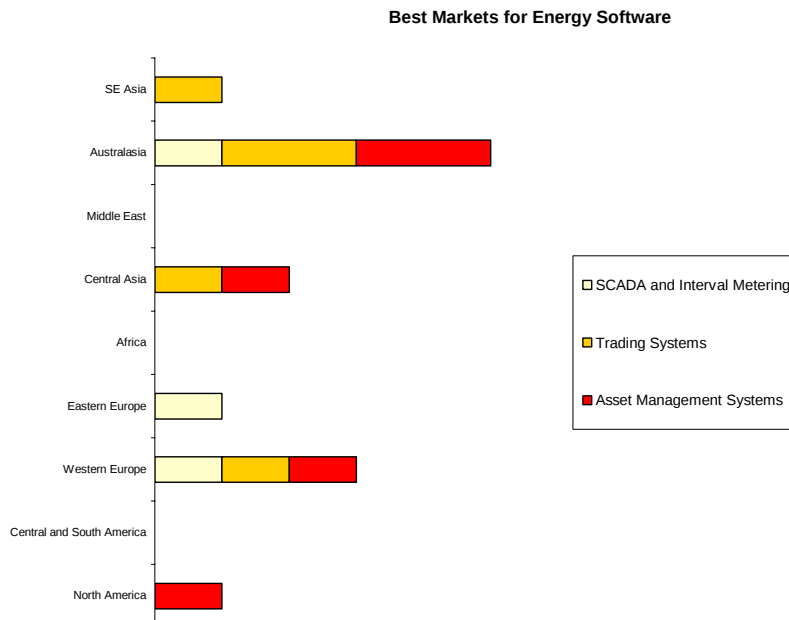
Australasia is also included, as it both includes New Zealand, and, in some cases, the vertical market potential may be equal or stronger outside Australia.

Figure 15. Vertical software market analysis: education



Source: CIIER Analysis.

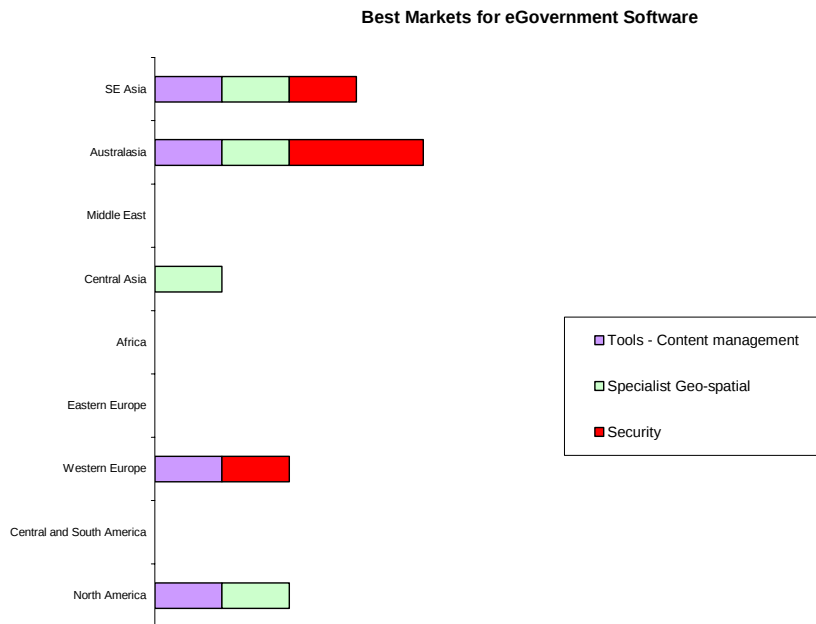
Figure 16. Vertical software market analysis: energy



Source: CIIER Analysis.

Note: CIIER considers the export opportunities for RTAC, GFAS, Risk Management and CIS billing to be low.

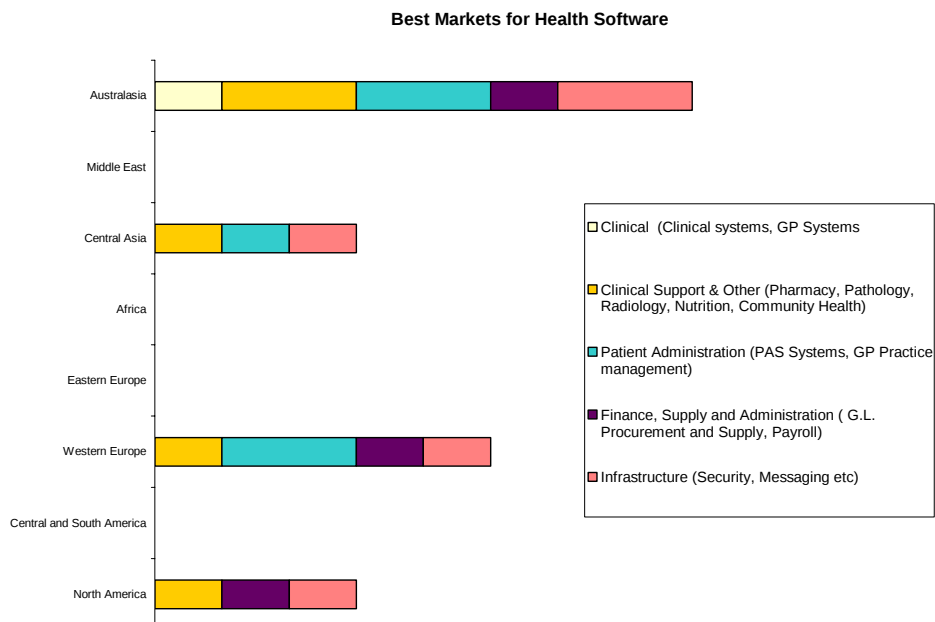
Figure 17. Vertical software market analysis: government



Source: CIIER Analysis.

Note: CIIER considers the market opportunities for Australian firms in specialist departmental software, tools (software development, payment Gateways and taxation) and basic infrastructure software to be low.

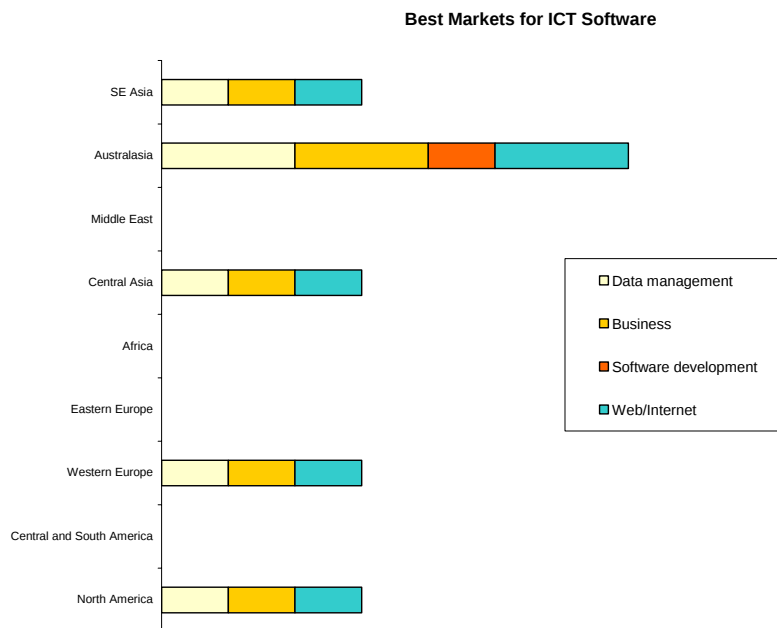
Figure 18. Vertical software market analysis: health



Source: CIIER Analysis.

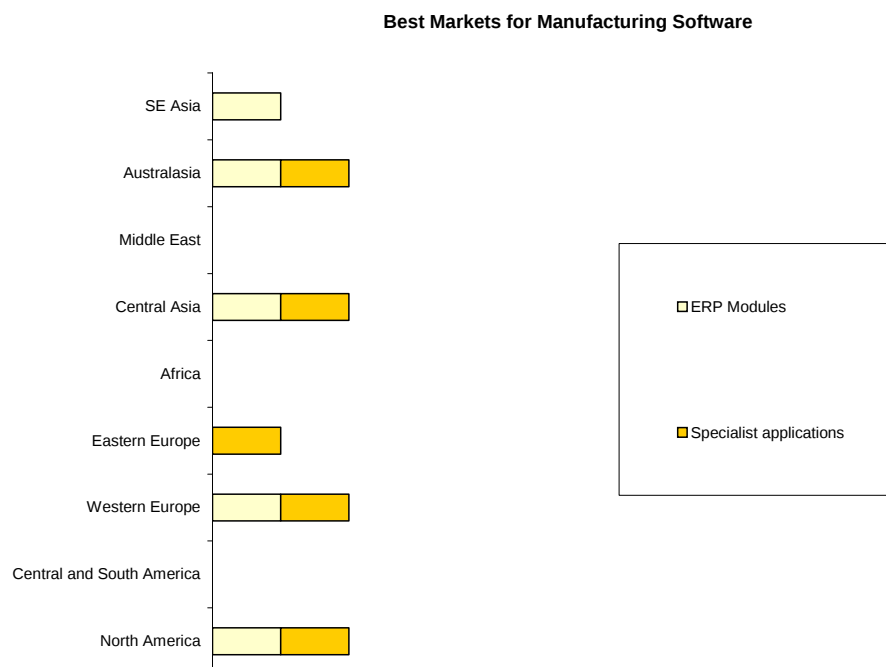
Note: CIIER considers that the export opportunities for Australian firms in medical devices software to be low.

Figure 19. Vertical software market analysis: ICT



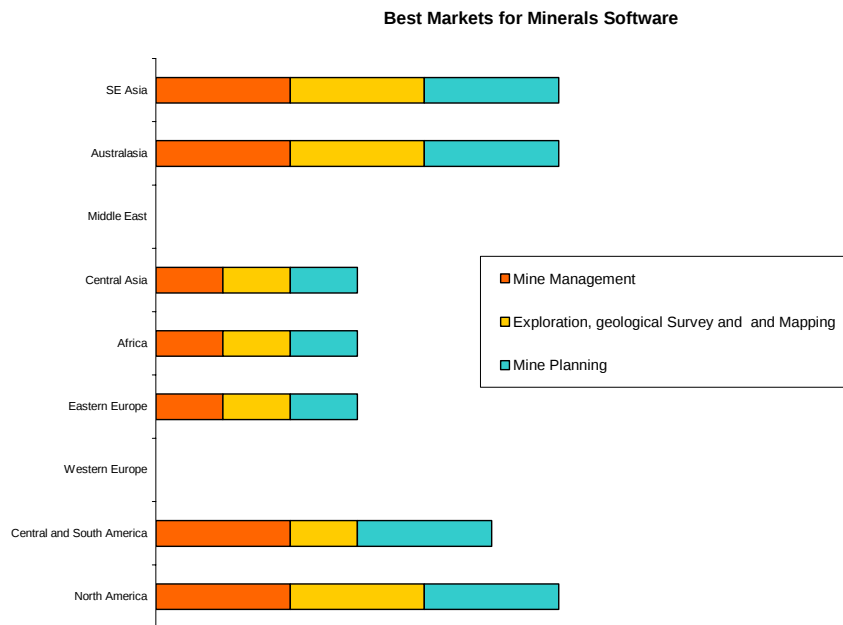
Source: CIIER Analysis.

Figure 20. Vertical software market analysis: manufacturing



Source: CIIER Analysis.

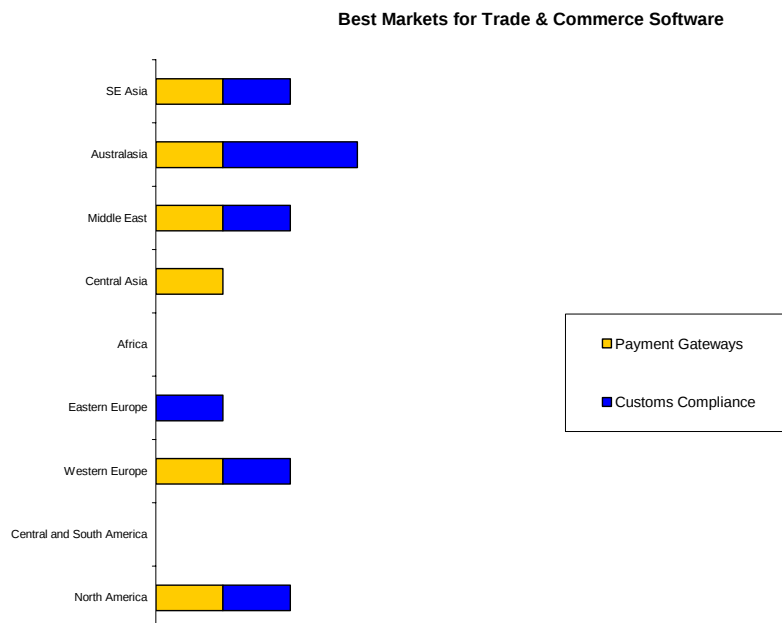
Figure 21. Vertical software market analysis: minerals



Source: CIIER Analysis.

Note: CIIER considers that export market opportunity for Australian firms to be low in telemetry.

Figure 22. Vertical software market analysis: trade and commerce



Source: CIIER Analysis.

Note: CIIER considers that the export opportunities for Australian firms to be low in supply chain and logistics and e-commerce platforms.

Export market conclusions

One result of this analysis is to show that the significance of regions for export potential by geographic region varies considerably for particular vertical markets, with minerals having the most divergent profile from other vertical markets, and thus likely requiring significantly different and tailored export programs.

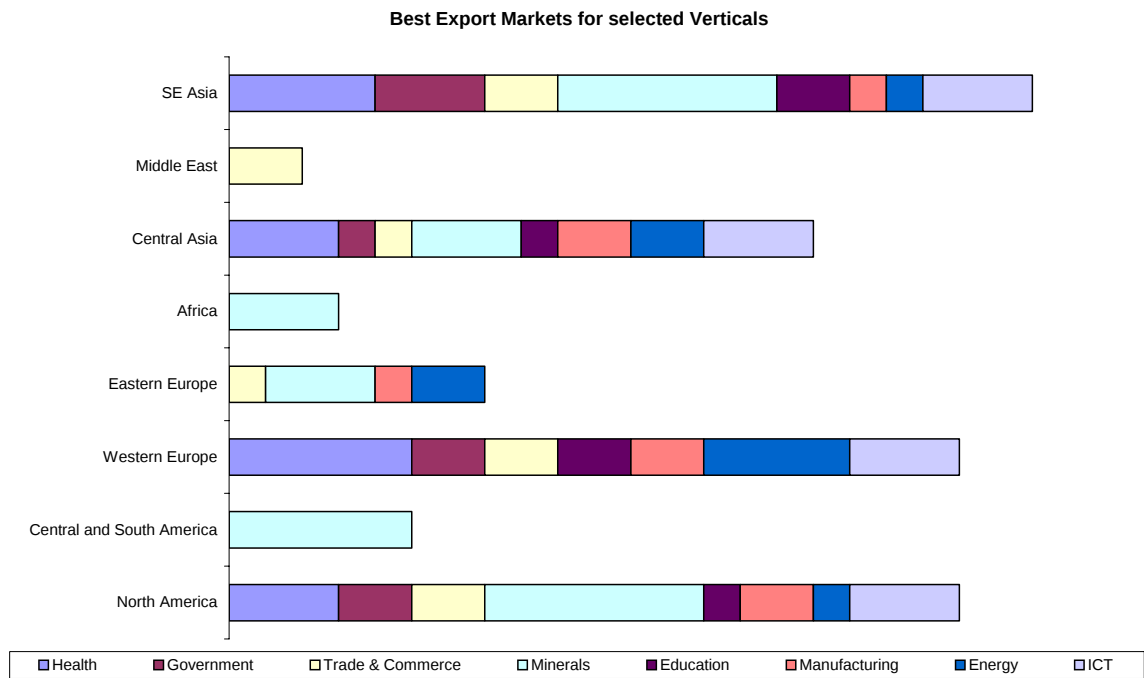
Another result is to show that, despite its relative size, North America may not offer the most responsive target. The ‘common heritage’ of the Commonwealth has resulted in a higher degree of commonality in practices and legislation (in health, education, government, and, to a lesser degree, energy) in regions including those countries within or formerly part of that grouping.

The most significant emerging markets in high growth regions of the world are in South East Asia, Central Asia and Eastern Europe, but the significance of each of these, and the merits of particular countries within the region, varies depending on the vertical market, and can vary considerably for particular sub-sectors within a specified vertical. As a general rule, however, those countries with greater cultural compatibility to Australia offer the easiest potential market entry (e.g. New Zealand, UK, Singapore, India, Canada, Malaysia).

We would recommend consideration by the ICT industry of a sectorally targeted software export strategy, based upon specific vertical market missions to selected regional and country targets. As each Australian state has different strengths and weaknesses in particular vertical sectors, it may be easier for some such missions to be state based, or jointly developed by key states within the vertical sector, rather than being necessarily national in nature.

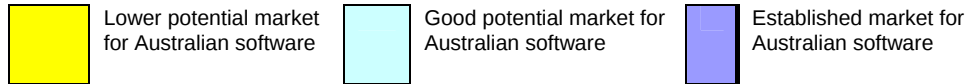
We would also recommend consideration of more structured links between firms within such sectors being explored, as the limited feedback derived from the various focus groups and case studies has indicated a commonality of interest and the potential for useful cooperation between Australian software developers who are interested in growing their businesses in the same vertical market.

Figure 23. Summary of export markets for selected verticals



The graph above summarises the results of the individual vertical market graphs, and aggregates the potential market indices for each vertical market within each region. As can be seen, Africa and Central and South America are considered viable targets for minerals software, whilst other regions have a broader potential on this analysis. As subsectors of the vertical markets selected can also vary considerably in potential, the following table shows the same data in a colour-coded tabular form.

Figure 24. Detailed summary of vertical software markets



Market		North America	Central and South America	Western Europe	Eastern Europe	Africa	Central Asia	Middle East	Australasia	SE Asia
	Designated sectors									
Major vertical	Designated sectors									
Health	Clinical									
	Clinical Support & Other									
	Medical devices									
	Patient Administration									
	Finance, Supply and Administration									
	Infrastructure									
Government	Basic infrastructure									
	Tools									
	Tools - Content management									
	Tools - Software development									
	Specialist departmental									
	Specialist Geo-spatial									
	Security									
Trade and commerce	e-Commerce Platforms									
	Payment Gateways									
	Supply Chain and Logistics									
	Customs Compliance									
Minerals	Mine Management									
	Exploration, Survey and Mapping									
	Telemetry									
	Mine Planning									
Education and science	e-learning									
	e-research									
	Other (Admin etc)									

Manufacturing	ERP Modules									
	Specialist applications									
Energy	SCADA and Interval Metering									
	Trading Systems									
	Asset Management Systems									
	RTAC									
	GFAS									
	Risk management									
	CIS and Billing									
ICT	Data management									
	Business									
	Software development									
	Web/Internet									

Source: CIER Analysis

Endnotes

- ¹ <http://www.opcfoundation.org>
- ² Kurt Yeager, past president and CEO of the Electric Power Research Institute.
- ³ Price Waterhouse Coopers (2005) *Under Pressure – Utilities Global Survey 2005*, PWC.
- ⁴ Price Waterhouse Coopers (2005) *Under Pressure – Utilities Global Survey 2005*, PWC.
- ⁵ Energy in Australia 2004: ABARE.
- ⁶ <http://www.minerals.nsw.gov.au/invest/petroleum/infrastructure>
- ⁷ Summary Report of the Independent Panel Electricity Distribution and Service Delivery for the 21st Century Queensland July 2004
- ⁸ Annual Planning Report - June 2005 : Electricity Supply Industry Planning Council
- ⁹ *ibid*
- ¹⁰ Different Worlds: strategic drivers of Australia's new energy industry: PWC 2001.
- ¹¹ Asia Pacific Energy, Utilities, Mining Investment Guide: Price Waterhouse Coopers, 2004.
- ¹² Australia - Multi-Utilities Markets: Paul Budde Communication Pty Ltd, July 2005..
- ¹³ *ibid*.
- ¹⁴ Australia's Energy Market – Drew Clark : Energy and Environment Division Department of Industry, Tourism and Resources Feb 2004
- ¹⁵ Australia's Energy Market – Drew Clark : Energy and Environment Division Department of Industry, Tourism and Resources Feb 2004
- ¹⁶ Asia Pacific Energy, Utilities, Mining Investment Guide: Price Waterhouse Coopers, 2004.
- ¹⁷ Allen Consulting: Economic Impacts of a National Energy Efficiency Target (NEET). April 2004.
- ¹⁸ Mandatory rollout of interval meters for electricity customers, Final Decision July 2004. Essential Services Commission.
- ¹⁹ Interval Metering Data Management Review, Workshop Presentation 9th December 2004.
- ²⁰ Solutions to Australia's Energy Greenhouse Challenge. (www.csiro.au).
- ²¹ <http://www.eia.doe.gov>
- ²² Price Waterhouse Coopers (2005) *Under Pressure – Utilities Global Survey 2005*, PWC.
- ²³ *Ibid*.
- ²⁴ European Energy and Transport Trends to 2030 – European Commission.
- ²⁵ Regional Overview: Asia-Pacific Economic Cooperation (APEC) 2002 – Energy Information Administration.
- ²⁶ Asia Pacific Energy, Utilities, Mining Investment Guide: Price Waterhouse Coopers, 2004.
- ²⁷ APEC Energy Supply and Demand Outlook 2002.
- ²⁸ APEC Energy Supply and Demand Outlook 2002.
- ²⁹ APEC Energy Supply and Demand Outlook 2002.
- ³⁰ 6th Annual Energy Transaction Software Guide 2004: Skipping Stone.
- ³¹ Beg, Borrow, Build or Buy How Vendors Are Changing the Face of Energy IT: Richter, Energy Transaction Software Guide 2002.
- ³² IDC IT Spending 2005
- ³³ 6th Annual Energy Transaction Software Guide 2004: Skipping Stone.
- ³⁴ Press Release: Aug 2004: Infonetrix.
- ³⁵ The growing power of automation, Michael Marullo; Energy Biz Magazine, Feb 2005.

-
- ³⁶ Gas Metering Estimation and Allocation Working Group: Government of Western Australia.
- ³⁷ Mandatory rollout of interval meters for electricity customers, Final Decision July 2004. Essential Services Commission.
- ³⁸ Interval Metering Data Management Review, Workshop Presentation 9th December 2004.
- ³⁹ The growing power of automation, Michael Marullo; Energy Biz Magazine, Feb 2005.
- ⁴⁰ Unified Operator Interface Enables Remote Operation / AGL Hallet & Somerton Power Station, Australia, Success Story, URL: www.yokogawa.com.
- ⁴¹ Electrical Equipment Manufacturing n.e.c. in Australia: Ibisworld Oct 2004.
- ⁴² www.citect.com
- ⁴³ Press Release: 6 April 2004 URL: www.citect.com.
- ⁴⁴ The growing power of automation, Michael Marullo; Energy Biz Magazine, Feb. 2005.
- ⁴⁵ Ibid.
- ⁴⁶ *ibid.*
- ⁴⁷ Panasonic Toughbook: Case Study May 2005 url: Panasonic.com.au.
- ⁴⁸ TUSC.com.au
- ⁴⁹ crcsi.com.au
- ⁵⁰ Enterprise Asset Management Market Is Dynamic with ASPs and CALM Business Model; LeRoy – ARC Advisory Group, Aug 2004.
- ⁵¹ Consolidate Business Functions with Utility Specific ERP: Kristian Steenstrup , Research Vice President, Gartner, Energy Central Dec. 2004.
- ⁵² The dearth of market information about this area is recognised as a potential research opportunity by IDC, who through their subsidiary Energy Insights will be conducting detailed research and analysis on IT systems in this segment, later in 2005. Energy Trading and Risk Management - Understanding the Costs of Information Technology: Energy Insights Prospectus 2005.
- ⁵³ CIS Industry Can Improve – Smith; Dec 2003 Wiglaf Journal.
- ⁵⁴ The State of Customer Information Systems, Causey; EnergyBiz Magazine April 2005.
- ⁵⁵ SAP for Utilities: Press Fact Sheet, April 2005: SAP.
- ⁵⁶ Energy Transformed Research Themes: URL: www.csiro.au.
- ⁵⁷ <http://www.cieam.com/>
- ⁵⁸ An Overview of Healthcare Information Standards: Jeffrey S. Blair; IBM Healthcare Solutions.
- ⁵⁹ Huws, U. and O'Regan, S. (2001) *eWork in Europe: The EMERGENCE 18-Country Employer Survey*, Report 380, Institute for Employment Studies, Brighton, p46.
- ⁶⁰ Dr Brian Richards, National Director E-Health Implementation, Department of Health and Ageing, 'Connecting for a health-e-future,' Health-e-Nation Conference, 9 March 2005.
- ⁶¹ CIIER, AHMAC, NHS, CanadaHealth Infoway.
- ⁶² Health Care in Australia: Department of Foreign Affairs and Trade website (www.dfat.gov.au).
- ⁶³ Ramsay develops big muscle : BRW April 2005.
- ⁶⁴ UK to give Sonic a shot in the Arm: SMH Feb 2005.
- ⁶⁵ Australian Institute of Health and Welfare (AIHW) 2004. Health expenditure Australia 2002–03. AIHW Cat. No. HWE 27 (Health and Welfare Expenditure Series No. 20). Canberra: AIHW
- ⁶⁶ Health expenditure Australia 2002–03 – Australian Institute of Health and Welfare.
- ⁶⁷ ABS (2005) *Australia Now: Health care delivery and financing*, Cat No 1301.0, Canberra.
- ⁶⁸ ABS (2005) *Private Hospitals, Australia*, Cat No 4390.0, Canberra.
- ⁶⁹ Frost and Sullivan.
- ⁷⁰ ABS.

-
- ⁷¹ Strategic Framework for IM & IT in General Practice 2001 – 2005: General Practice Computing Group.
- ⁷² GPCG Work Program: Phase Two. The General Practice Computing Group's funding will cease in September 2005. See Medical Observer Weekly (<http://www.medicalobserver.com.au/>).
- ⁷³ Identifying International Healthcare IT business opportunities for small and medium size British Firms – Frost and Sullivan Dec 2003 & IntellectUK.
- ⁷⁴ www.who.int/countries/en/
- ⁷⁵ Health expenditure Australia 2002–03 – Australian Institute of Health and Welfare.
- ⁷⁶ Identifying International Healthcare IT business opportunities for small and medium size British Firms – Frost and Sullivan Dec 2003 & IntellectUK.
- ⁷⁷ OECD: OECD Health Data 2005: How Does Germany Compare.
- ⁷⁸ e-Health Media Ltd (<http://www.e-health-insider.com/news/item.cfm?ID=1140>).
- ⁷⁹ Department of Health UK.
- ⁸⁰ National Programme for IT in the NHS: (URL: <http://www.npfit.nhs.uk/>).
- ⁸¹ NHS National Programme for IT Annual Report 2004.
- ⁸² Market Profiles: Frost and Sullivan for IntellectUK Nov 2003.
- ⁸³ A review of computerised information technology systems in general practice medicine: R. Didham RNZCGP Research Unit.
- ⁸⁴ *ibid.*
- ⁸⁵ US Health Care Spending In An International Context; Reinhardt et al, 2004 : Abstract.
- ⁸⁶ Why the United States Has No National Health Insurance: Stakeholder Mobilisation Against the Welfare State, 1945–1996* ; J. Quadagno - Journal of Health and Social Behavior 2004.
- ⁸⁷ Identifying International Healthcare IT Business Opportunities For Small & Medium-sized British Companies : Phase 2 In-depth Analysis Of The Canadian Healthcare IT Market ; Frost and Sullivan; May 2004.
- ⁸⁸ Facts on the Cost of Health Care : 2004 National Coalition on Health Care.
- ⁸⁹ Health Expenditures in Canada by Age and Sex, 1980-81 to 2000-01: Health Canada 2001.
- ⁹⁰ HIPAAAdvisory.com.
- ⁹¹ Health Information Technology Leadership panel – Final Report – May 2005: the Lewin Group.
- ⁹² How Big is the Health I.T. Market?: Healthdatamanagement.com; July 2005.
- ⁹³ Market Profiles: Frost and Sullivan for IntellectUK Nov 2003.
- ⁹⁴ Canada Health Infoway (<http://www.canadahealthinfoway.com/>).
- ⁹⁵ A review of computerised information technology systems in general practice medicine: R. Didham RNZCGP Research Unit.
- ⁹⁶ Market Profiles: Frost and Sullivan for IntellectUK Nov 2003.
- ⁹⁷ Market Profiles: Frost and Sullivan for IntellectUK Nov 2003.
- ⁹⁸ Ministry of Health Malaysia.
- ⁹⁹ Dreaming with BRICs: The Path to 2050 – Goldman Sachs 2003.
- ¹⁰⁰ WHO.
- ¹⁰¹ India Medical Tourism Expo 05 – Wood Green London (<http://ibeworld.com/medical-industry.htm>).
- ¹⁰² CII-McKinsey report cited in Express Health Care Management.
- ¹⁰³ Nimish R Parekh Chief Executive Officer United Healthcare India Group Firms.
- ¹⁰⁴ Ministry of Health New Zealand.
- ¹⁰⁵ Didham R, Martin IR, Wood R, Harrison K. Information Technology systems in general practice medicine in New Zealand. NZ Med J 2004; 117(1198):U977.

-
- ¹⁰⁶ IT Issues and Trends –Clinical Information Systems; PWC 2003 (www.pwchealth.com).
- ¹⁰⁷ Picture blurs on IBA: Australian Financial Review 14th July 2005 p22.
- ¹⁰⁸ Intelligent Solutions for Radiology Data Management and Storage: Lucier, Wanchoo 2002. (www.healthmgttech.com).
- ¹⁰⁹ Business Communication Company Press Release: Jan 2005.
- ¹¹⁰ Intersystems Press Release: July 2003 (www.intersystems.com.au).
- ¹¹¹ Ibid.
- ¹¹² Frost and Sullivan, ‘Identifying International Healthcare IT business opportunities for small and medium size British Firms’, Intellect UK, Dec 2003.
- ¹¹³ Facts on medical Devices: Aus Biotech.
- ¹¹⁴ See www.miaa.org.au.
- ¹¹⁵ Action Agendas Newsletter; Dept. Industry Tourism & Resources; Edition One April 2005.
- ¹¹⁶ Information provided by DCITA to report authors.
- ¹¹⁷ Ibid.
- ¹¹⁸ Ibid.
- ¹¹⁹ Woodhead, B. (2005) ‘HealthSmart project enters crucial phase,’ *Australian Financial Review* 19 July 2005, p26.
- ¹²⁰ Information provided by DCITA to report authors.
- ¹²¹ (www.chi.unsw.edu.au/partners/partners.html).
- ¹²² Ibid.
- ¹²³ CRC Website (<http://www.cssip.edu.au/research/Medicalimaging.html>).
- ¹²⁴ CRC Website (<http://www.bionicear.org/crc/>).
- ¹²⁵ Software developer at DFAT forum, March 2002.
- ¹²⁶ WITSA Digital Planet 2004, The Global Information Economy.
- ¹²⁷ WITSA Digital Planet 2004, The Global Information Economy.
- ¹²⁸ WITSA Digital Planet 2004, The Global Information Economy.
- ¹²⁹ WITSA Digital Planet 2004, The Global Information Economy.
- ¹³⁰ WITSA Digital Planet 2004, The Global Information Economy.
- ¹³¹ WITSA Digital Planet 2004, The Global Information Economy.
- ¹³² WITSA Digital Planet 2004, , The Global Information Economy.
- ¹³³ Austrade. Assisting Australian Exporters. Information technology to India Report.
- ¹³⁴ Hashida Newsletter 2005-6 compiled by Kumio Hashida, Former Chairman Japan IT Services Industry Association.
- ¹³⁵ Hashida Newsletter 2005-6 compiled by Kumio Hashida. Former Chairman Japan IT Services Industry Association.
- ¹³⁶ Case study Response
- ¹³⁸ ABS Business Use of ICT 2003 data
- ¹³⁹ ABS Business Use of Information Technology 2003-04, Cat No 8129.0, March 2005
- ¹⁴⁰ ABS Business Use of Internet 2003
- ¹⁴¹ Melbourne Focus Group respondent
- ¹⁴² ABS Business Use of ICT Australia
- ¹⁴³ Melbourne Focus Group attendee

**Centre for Innovative Industry Economic
Research Consortium**

**The Australian software industry and
vertical applications markets:
Globally competitive and
domestically undervalued**

Appendices

Annex 1 Project team

The project team was formed under the aegis of the Centre for Innovative Industry Economic Research Inc. (CIIER). This newly formed body brings together researchers and industry bodies to further our understanding of the innovative industries—information and communications technology; biotechnology; nanotechnology; and environmental technology. The project team was supported by the Australian Computer Society (ACS), the Australian Information Industry Association (AIIA), and the Pearcey Foundation.

Ian Dennis	Project director / senior researcher	Whitehorse Strategic Group/CIIER
John Houghton	Senior researcher	Centre for Strategic and Economic Studies, Victoria University
Richard Hogg	Senior researcher / consultation forums	RGH Consulting
Brett McLean	Senior analyst	Whitehorse Strategic Group
Tina Xydias	Workshop coordination	Pearcey Foundation/Innovation Events
Robert Eames	Senior analyst	Fivenines Consulting
Phil Singleton	Consultation forums	Private consultant

The consultants listed above are experienced in information technology, information engineering, software and services, and ICT strategic matters; have worked in large, medium and small Australian and International firms in the Australian ICT industry; have experience in both importing and exporting software and services; and three of them have played key roles in significant industry bodies and associations, including AIIA, ACS, and the Pearcey Foundation. Collectively, they represent over 250 years of Australian ICT experience.

By necessity, some opinions have been expressed in this report. These are derived from the collective wisdom of the consultants, informed by input from industry sources, and from the many previous government and industry reports addressing this issue and related matters. The opinions expressed in the body of this report are those of members of the consulting team, and do not necessarily represent the opinion of the Australian Government, or of the state governments and industry bodies which have supported this project.

Annex 2 National research priorities

Research priority 1: an environmentally sustainable Australia

- Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies
- Water—a critical resource
- Sustainable ways of improving water productivity, using less water in agriculture and other industries, providing increased protection of rivers and groundwater and the re-use of urban and industrial waste waters.
- Transforming existing industries
- New technologies for resource based industries to deliver substantial increases in national wealth while minimising environmental impacts on land and sea.
- Overcoming soil loss, salinity and acidity
- Identifying causes and solutions to land degradation using a multidisciplinary approach to restore land surfaces.
- Reducing and capturing emissions in transport and energy generation
- Alternative transport technologies and clean combustion and efficient new power generation systems and capture and sequestration of carbon dioxide.
- Sustainable use of Australia's biodiversity
- Managing and protecting Australia's terrestrial and marine biodiversity both for its own value and to develop long term use of ecosystem goods and services ranging from fisheries to ecotourism.
- Developing deep earth resources
- Smart high-technology exploration methodologies, including imaging and mapping the deep earth and ocean floors, and novel efficient ways of commodity extraction and processing (examples include minerals, oil and gas) while minimising negative ecological and social impacts.
- Responding to climate change and variability
- Increasing our understanding of the impact of climate change and variability at the regional level across Australia, and addressing the consequences of these factors on the environment and on communities.

Research priority 2: promoting and maintaining good health

- Promoting good health and well being for all Australians
- A healthy start to life
- Counteracting the impact of genetic, social and environmental factors which predispose infants and children to ill health and reduce their well being and life potential.
- Ageing well, ageing productively
- Developing better social, medical and population health strategies to improve the mental and physical capacities of ageing people.
- Preventive healthcare
- New ethical, evidence based strategies to promote health and prevent disease through the adoption of healthier lifestyles and diet, and the development of health-promoting products.
- Strengthening Australia's social and economic fabric
- Understanding and strengthening key elements of Australia's social and economic fabric to help families and individuals live healthy, productive, and fulfilling lives.

Research priority 3: frontier technologies

- for building and transforming Australian industries
- Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research
- Breakthrough science
- Better understanding of the fundamental processes that will advance knowledge and facilitate the development of technological innovations.
- Frontier technologies
- Enhanced capacity in frontier technologies to power world-class industries of the future and build on Australia's strengths in research and innovation (examples include nanotechnology, biotechnology, ICT, photonics, genomics/phonemics, and complex systems).
- Advanced materials
- Advanced materials for applications in construction, communications, transport, agriculture and medicine (examples include ceramics, organics, biomaterials, smart material and fabrics, composites, polymers and light metals).
- Smart information use

- Improved data management for existing and new business applications and creative applications for digital technologies (examples include e-finance, interactive systems, multi-platform media, creative industries, digital media creative design, content generation and imaging).
- Promoting an innovation culture and economy
- Maximising Australia's creative and technological capability by understanding the factors conducive to innovation and its acceptance.

Research priority 4: safeguarding Australia

- Safeguarding Australia from terrorism, crime, invasive diseases and pests, strengthening our understanding of Australia's place in the region and the world, and securing our infrastructure, particularly with respect to our digital systems
- Protecting Australia's critical infrastructure including our financial, energy, communications, and transport systems
- Understanding our region and the world
- Enhancing Australia's capacity to interpret and engage with its regional and global environment through a greater understanding of languages, societies, politics and cultures.
- Protecting Australia from invasive diseases and pests
- Counteract the impact of invasive species through the application of new technologies and by integrating approaches across agencies and jurisdictions.
- Protecting Australia from terrorism and crime
- By promoting a healthy and diverse research and development system that anticipates threats and supports core competencies in modern and rapid identification techniques.
- Transform military operations for the defence of Australia by providing superior technologies, better information and improved ways of operation.

CSIRO flagship programs

In 2003, the Commonwealth Scientific and Industry Research Organisation (CSIRO) established six flagship programs with the objective of achieving some audacious goals over the next ten years.

- Preventative health—to improve the health and well being of Australians and save \$2 billion in annual direct health costs by 2020 through the prevention and early detection of chronic diseases

- Light metals—to lead a global revolution in light metals, doubling export income and generating significant new industries for Australia by the 2020s while reducing environmental impact.
- Food futures—to transform the international competitiveness and add \$3 billion annually to the Australian agrifood sector by the application of frontier technologies to high-potential industries
- Energy transformed—to halve greenhouse gas emissions and double the efficiency of the nation’s new energy generation, supply and end use, and to position Australia for a future hydrogen economy
- Water for a healthy country—to achieve a tenfold increase in the social, economic and environmental benefits from water by 2025
- Wealth from oceans—to position Australia by 2020 as an international benchmark in the delivery of economic, social and environmental wealth based on leadership in understanding ocean systems and processes

Cooperative research centres

The Cooperative Research Centres (CRC) program was established in 1990 to improve the effectiveness of Australia’s research and development effort. It links researchers with industry to focus R&D efforts on progress towards utilisation and commercialisation. The close interaction between researchers and the users of research is a key feature of the program.

When all CRCs from the 2004 selection round are established, there will be 72 CRCs operating in six sectors: environment, agriculture, information and communications technology, mining, medical science and technology and manufacturing.

Manufacturing technology

CRC for Advanced Composite Structures

CRC for Bioproducts

CRC for CAST Metals Manufacturing

CRC for Construction Innovation

CRC for Functional Communication Surfaces

CRC for Intelligent Manufacturing Systems and Technologies

CRC for MicroTechnology

CRC for Polymers

CRC for Railway Engineering and Technologies

CRC for Welded Structures

CRC Wood Innovations

CRC for Advanced Automotive Technology

Information and communications technology

Australasian CRC for Interaction Design
 Australian Photonics CRC
 Australian Telecommunications CRC
 CRC for Enterprise Distributed Systems Technology
 CRC for Integrated Engineering Asset Management
 CRC for Satellite Systems
 CRC for Sensor Signal and Information Processing
 CRC for Smart Internet Technology
 CRC for Spatial Information
 CRC for Technology Enabled Capital Markets

Mining and energy

Parker CRC for Integrated Hydrometallurgy Solutions
 CRC for Clean Power from Lignite
 CRC for Coal in Sustainable Development
 CRC for Greenhouse Gas Technologies
 CRC for Landscape Environments and Mineral Exploration
 CRC for Predictive Mineral Discovery
 CRC for Sustainable Resource Processing
 CRC Mining

Agriculture and rural based manufacturing

Australian Biosecurity CRC for Emerging Infectious Disease
 Cotton Catchment Communities CRC
 Australian Sheep Industry CRC
 CRC for the Australian Poultry Industries
 CRC for Beef Genetic Technologies
 CRC for Innovative Dairy Products
 CRC for Innovative Grain Food Products
 CRC for Sugar Industry Innovation through Biotechnology
 CRC for Sustainable Aquaculture of Finfish
 CRC for Sustainable Forest Landscapes
 CRC for Sustainable Rice Production
 CRC for Tropical Plant Protection
 CRC for Value Added Wheat

CRC for Viticulture
 CRC for Molecular Plant Breeding
 CRC for an Internationally Competitive Pork Industry
 CRC for National Plant Biosecurity

Environment

Bushfire CRC
 CRC for Antarctic Climate and Ecosystems
 CRC for Australian Weed Management
 Australasian Invasive Animal CRC
 CRC for Catchment Hydrology
 CRC for Coastal Zone, Estuary and Waterway Management
 CRC for Freshwater Ecology
 CRC for the Great Barrier Reef World Heritage Area
 CRC for Greenhouse Accounting
 CRC for Irrigation Futures
 CRC for Plant based Management of Dryland Salinity
 CRC for Sustainable Tourism
 CRC for Tropical Rainforest Ecology and Management
 CRC for Tropical Savannas Management
 e-Water CRC
 Desert Knowledge CRC
 Environmental Biotechnology CRC
 CRC for Contamination Assessment and Remediation of the Environment

Medical science and technology

CRC for Aboriginal Health
 CRC for Asthma and Airways
 CRC for Cellular Growth Factors
 CRC for Chronic Inflammatory Diseases
 CRC for Cochlear Implant and Hearing Aid Innovation
 CRC for Diagnostics
 CRC for Discovery of Genes for Common Human Diseases
 CRC for Oral Health Science
 CRC for Vaccine Technology
 The Vision CRC

Completed CRCs

The following CRCs have completed their terms and are not included in the list above (although some have developed into new CRCs):

Australian CRC for Renewable Energy

Australian Petroleum CRC

CRC for Antarctica and the Southern Ocean

CRC for Conservation and Management of Marsupials

CRC for Eye Research and Technology

CRC for International Food Manufacturing and Packaging Science

CRC for Mining Technology and Equipment

CRC for Molecular Plant Breeding

CRC for Sustainable Sugar Production

CRC for Tissue Growth and Repair

CRC for Waste Management and Pollution Control

Annex 3 Data for selected figures Part B

(Part B)

Data for figure 15. Total ICT spending by the manufacturing sector in selected countries, 2004 and 2007

Country	Expenditure USD 2004	Expenditure USD 2007	Estimated growth rate 2004-07 (per cent change)
South America	\$9,013	\$9,856	9.35%
Malaysia	\$3,592	\$4,066	13.20%
North America	\$108,191	\$125,517	16.01%
Philippines	\$1,032	\$1,217	17.93%
India	\$4,600	\$6,202	34.83%
Indonesia	\$1,509	\$6,202	40.65%
China	\$37,835	\$55,068	45.55%

(Part C)

Data for figure 13.

	USDm 2002	USDm 2003	USDm 2004	USDm 2005	USDm 2006	USDm 2007
Japan	13,100	14,289	15,438	16,410	18,483	19,770
China PRC	2,252	3,107	3,900	4,837	6,011	7,085
Australia	2,698	2,994	3,074	3,291	3,580	3,890
Republic of Korea	1,116	1,360	1,645	1,993	2,729	3,399
Taiwan	739	860	1,010	1,182	1,383	1,625
India	588	720	902	1,084	1,314	1,611
Other Countries	2,410	2,842	3,399	4,061	4,903	5,986

Source /WITSA. Digital Planet2004, The Global Information Economy

List of acronyms

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACA	Australian Communications Authority
ACMA	Australian Communications and Media Authority
ACS	Australian Computer Society
ADP	automatic data processing
AGIMO	Australian Government Information Management Office
AGL	Australian Gas Light
AHIC	Australia Health Information Council
AHMAC	Australian Health Ministers Advisory Council
AIIA	Australian Information Industry Association
AMIRA	Australian Mining Industry Research Association
AMS	asset management systems
ANZSIC	Australian and New Zealand Standard Industry Classification
API	application programming interface
ARA	Australian Retailers Association
ASOCIO	Asian–Oceanian Computing Industry Organisation
ASP	application service provider
ATM	automatic teller machine
AUD	Australian dollar
B2B	business to business
B2C	business to consumer
BCIS	billing and customer information system
BCS	basic carriage services
BERD	business expenditure on research and development
BIE	Bureau of Industry Economics
CAD	computer aided design
CAD/CAM	computer aided design/computer aided manufacture
CAGR	compound annual growth rate
CEO	chief executive officer
CIEAM	Cooperative Research Centre for Integrated Engineering Asset Management
CIF	cost insurance freight
CIER	Centre for Innovation Industry Economic Research
CIO	chief information officer

CISRA	Canon Information Systems Research Australia
CITEC	Communications IT & e-Commerce board
CLS	costing and logistic systems
CMP	cellular mobile telephone
CNC	computer numerical control
COS	central office switch
CPE	customer premises equipment
CPFR	collaborative planning forecasting and replenishment
CRC	cooperative research centre
CRC-IMST	Cooperative Research Centre for Intelligent Manufacturing Systems & Technologies
CRM	customer relationship management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DASD	direct access storage device
DCITA	Department of Communications Information Technology and the Arts
DDSN	demand driven supply network
DSTC	Distributed Systems Technology Centre
DSTO	Defence Science and Technology Organisation
E.HR	electronic health records
EAM	enterprise asset management
EAS2	electronic advice of sale
EBPP	electronic bill payment and presentation
ED	electronic data processing
EDI	electronic document interchange
EdNA	Education Network Australia
EFT	electronic funds transfer
EFTPOS	electronic funds transfer at point of sale
EHR	electronic health record
ELX	electronic labour exchange
EP	electronic procurement
ERP	enterprise resource planning
EU	European Union
FAS	financial accounting system
F3	Framework for the Future
FM	facilities management
FOB	free on board
FTAs	free trade agreements
GBP	pounds sterling
GDP	gross domestic product
GERD	gross expenditure on research and development

GFAS	geospatial and field automation solutions
GIS	geographic information systems
GLS	government licensing system
GOE	generic office environment
GPCG	General Practice Computing Group
GW	gateways
HCN	Health Communications Network
HHS	health and human service
HIPAA	Health Insurance Portability and Accountability Act
HLS	higher level services
HMI	human machine interface
HMO	health management organisations
HRMIS	human resource management information system
IAP	internet access provider
IC	integrated circuit
ICT	information and communications technology
IDA	Infocomm Development Authority
IDC	International Data Corporation
IDD	international direct dialling
IMSC	Information Management Strategy Committee
IO	input-output
IP	internet protocol
IPR	intellectual property rights
IS	information services
ISD	international subscriber dialling
ISDN	integrated services digital network
ISP	internet service provider
IT	information technology
ITOL	Information Technology Online Program
IVAN	international value-added network
JISC	Joint Information Systems Committee
KTS	key telephone system
LAN	local area network
LGSS	Local Government Spatial Solution
LIS	land information systems
LMS	learning management systems
MES	manufacturing execution systems
MIS	management information systems
MIT	Massachusetts Institute of Technology
MMUs	mobile manufacturing units
MMV	Multimedia Victoria

MNCs	multinational corporations
MNE	multinational enterprise
NEHTA	National e-Health Transition Authority
NEMMCO	National Electricity Market Management Company
NHIG	National Health Information Group
NHS	National Health Service
NICTA	National ICT Australia Limited
NOIE	National Office for the Information Economy
NSCTF	National Supply Chain Reform Task Force
OECD	Organisation for Economic Co-operation and Development
OeG	Office of e-Government
OEM	original equipment manufacturers
OES	operational efficiency systems
OSS	open source software
OSS	operational support system
OTLF	one time licence fee
PABX	private automatic branch exchange
PACS	picture archiving and communications systems
PAS	patient administration system
PC	personal computer
PCB	printed circuit board
PCS	personal communications system
PDA	personal digital assistant
PGEs	platinum group elements
PLC	programmable logic controllers
PLMS	product lifecycle management systems
POS	point of sale
PRC	Peoples Republic of China
PSDN	packet switched data network
PSTN	public switched telephone network
QMAS	quality management application system
R&D	research and development
RAPSIM	rapid simulation
RFID	radio frequency identification device
RIS	Radiology Information Systems
RTAC	real time automation & control
SaaS	software as a service
SCADA	supervisory control and data acquisition
SCM	supply chain management
SEA	Software Engineering Australia

SEO	social economic objective
SI	systems integration
SKU	stock keeping unit
SLIP	shared land information platform
SMEs	small to medium enterprises
SOHO	small office/home office
SSQ	Smart Service Queensland
STD	subscriber trunk dialling
STI	science, technology and innovation
SUS	secondary uses service
SWOT	strengths, weaknesses, opportunities, threats
T&RMS	Trading and Risk Management Systems
TAFE	technical and further education
USD	US Dollar
US-FTA	US Free Trade Agreement
VAN	value-added network
VAS	value-added services
VET	vocational education and training
VoIP	voice over internet protocol
VPN	virtual private network
WA:ERA	Western Australian Energy Research Alliance
WAN	wide area network
WITSA	World Information Technology Services Alliance