

Impact of the ICT Industry in Australia



Australian Computer Society

www.acs.org.au

This report was researched and written by:

Professor John W. Houghton

Centre for Strategic Economic Studies

Ph: +61 2 6282 1981 Mobile: (Australian) 0409 239 109

E-mail: John.Houghton@pobox.com

Prepared for:

Australian Computer Society

PO Box Q534

Queen Victoria Building

Sydney

NSW 1230

Ph: +61 2 9299 3666 Fax: +61 2 9299 3997

Web: <http://www.asc.org> E-mail: info@acs.org.au

Table of Contents

TABLE OF CONTENTS	I
SUMMARY.....	II
ICTS IN AUSTRALIA.....	1
THE ICT INDUSTRIES IN AUSTRALIA	2
EMPLOYMENT IN THE ICT-PRODUCING INDUSTRIES.....	2
ICT-PRODUCING INDUSTRIES' INCOME	4
ICT-PRODUCING INDUSTRIES' CONTRIBUTION TO GDI.....	5
ICT EMPLOYMENT IN AUSTRALIA.....	7
ICT JOBS IN AUSTRALIA.....	7
TOTAL ICT AND RELATED EMPLOYMENT	10
EXPENDITURE ON ICTS IN AUSTRALIA	12
AUSTRALIAN MARKET EXPENDITURE ON ICTS.....	12
COMPARATIVE MARKET AND INTERNAL ICT EXPENDITURES.....	13
SECTORAL EXPENDITURES ON ICTS.....	14
CAPITAL INVESTMENT IN ICTS.....	15
THE BENEFITS OF ICTS	17
WHAT ARE WE LOOKING FOR?.....	17
OVERSEAS EVIDENCE OF THE CONTRIBUTION OF ICTS.....	17
THE AUSTRALIAN CASE: THE IMPACT OF ICTS IN AUSTRALIA	24
SUMMARY	28
APPENDIX A DEFINING ICTS.....	29
NOTES	31

Summary

Information and Communication Technology industries are large and rapidly growing, but it is the enabling impact of ICTs across the economy that promises most. This report attempts to quantify the impact of ICTs in Australia.

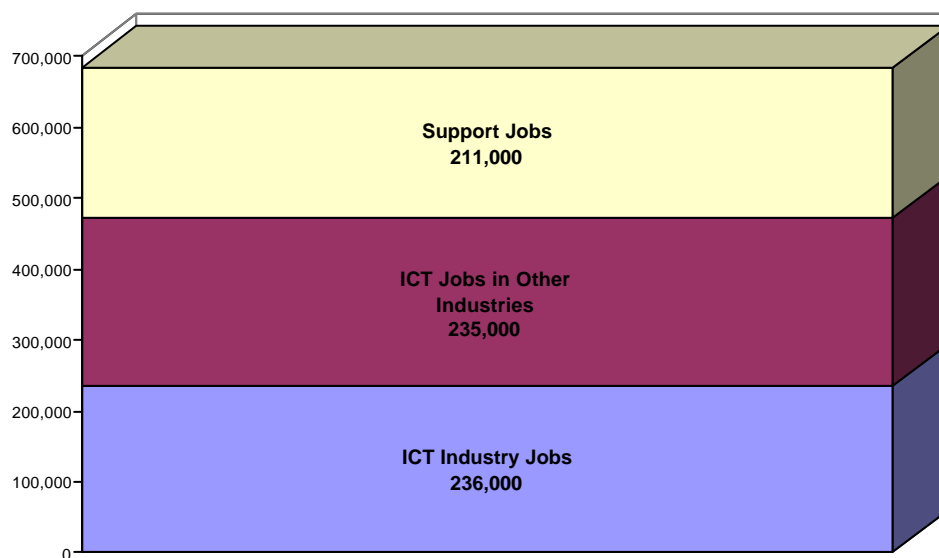
It shows that:

- As many as 680,000 Australians work in ICT and related support jobs, depending upon ICTs for their livelihood;
- ICT employment is growing *and* becoming increasingly highly paid;
- Industry income is around \$100 billion a year, and has been increasing at an average annual rate of more than 17 per cent through the 1990s;
- Australians are amongst the most intensive users of ICTs in the world, ranking 4th among OECD countries in terms of the ratio of ICT expenditure to Gross Domestic Product; and
- The ICT-producing industries make a smaller direct contribution in Australia than they do in other developed countries, but evidence of the benefits of ICT investment and usage is now emerging.

Employment

ICT jobs include those directly employed in the ICT-producing industries, ICT jobs in other industries and related support jobs.

Figure 1 How ICT jobs stack up



Source: ABS, own analysis.

There are around 235,000 Australians employed in the main ICT-producing industries – 2.7 per cent of Australia's total employment. Around 73,000 jobs have been created within the industries since 1993 – equivalent to 6.7 per cent of the total increase in jobs in Australia over the period.

ICT industry jobs are higher paying than jobs in most other industries. In 1998-99, specialist ICT producers paid wages and salaries equivalent to \$51,243 per annum, compared to average wages and salaries per employee in Australia of just \$29,409.

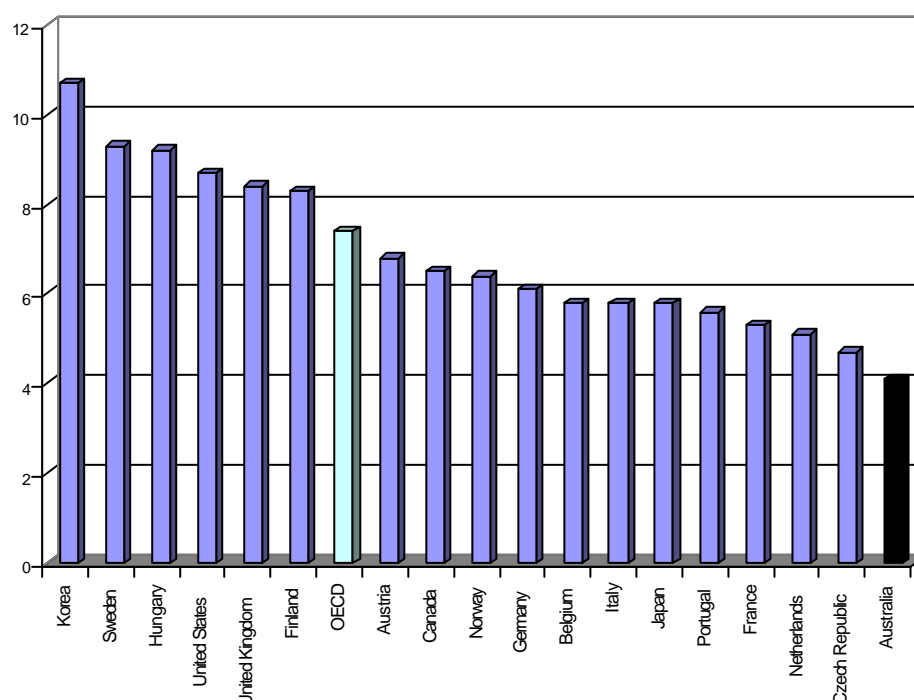
In late 2000, there were 340,700 people employed in ICT jobs in Australia – up by 76,900 since 1996. ICT employment in Australia has increased at a compound annual rate of 6.6 per cent since 1996, compared to an economy-wide job growth of 2.1 per cent.

Adding ICT-producing industry jobs, ICT jobs in other industries and estimated ICT support jobs in other industries suggests that there are at least 683,000 Australians depending directly upon ICTs for their livelihood.

ICT industry income

The core ICT-producing industries earned income approaching \$74 billion in 1998-99, and are expected to earn close to \$100 billion during 2000-01.

Figure 2 Share of ICT industries value added in total business sector value added in OECD countries, circa 1998 (%)



Source: OECD (2000) *Measuring the ICT Sector*, OECD, Paris.

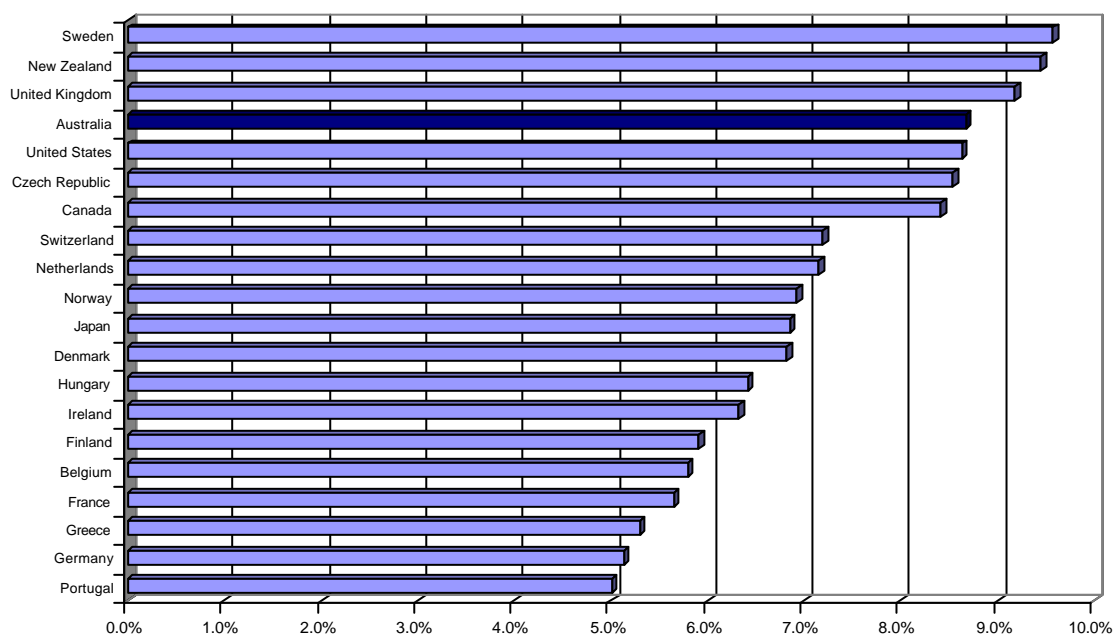
The contribution of the ICT-producing industries to the Australian economy is increasing. In 1992-93, ICT industry income was the equivalent of 5.2 per cent of Gross Domestic Income. By 1998-99, it was equivalent to 7.5 per cent. Between 1992-93 and 1998-99, the increase in ICT-producing industry income was equivalent to 13 per cent of the increase in total Gross Domestic Income, suggesting that the ICT industries are making a significant contribution to economic growth.

While large by national standards, Australia's ICT industries are a relatively small part of the economy compared to other OECD countries. Consequently, the Australian ICT industries are contributing less to the Australian economy than they could be with further development.

Expenditure on ICTs

On any measure, Australians are among the most intensive users on ICTs in the world. In 1999, Australia ranked 4th among OECD countries in terms of the ratio of ICT expenditure to Gross Domestic Product – behind Sweden, New Zealand and the United Kingdom. Australians spent the equivalent of 7.2 per cent of GDP on ICTs in 1992, rising to 8.7 per cent in 1999.

Figure 3 Ratio of ICT expenditure to Gross Domestic Product, 1999



Source: World Information Technology and Services Alliance (2000) *Digital Planet 2000: The Global Information Economy*, WITSA.

Impact of ICTs

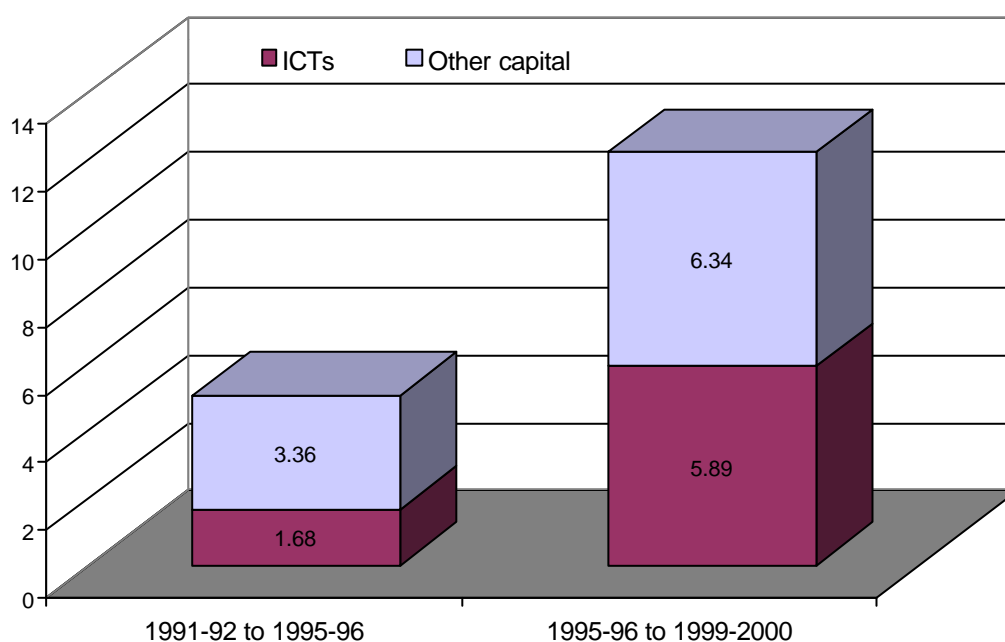
The key question is whether this ICT-related investment brings benefits for Australians. It is also one of the most difficult questions to answer, but there is increasing evidence to suggest that ICT investments are paying off.

In a study of the potential aggregate and sectoral impacts of e-commerce in Australia, NOIE suggested that increased use of e-commerce could:

- boost national output by 2.7 per cent over the next decade – worth of the order of \$14 billion per annum;
- increase real investment by 4 per cent, and consumption by 3 per cent;
- increase aggregate employment by 0.5 per cent and real wages by 3.5 per cent; and
- contribute 2 per cent to an appreciation of the real exchange rate.

Our own analysis suggests that ICT investments are contributing to productivity improvements across the economy, and that contribution is increasing.

Figure 4 Contribution of ICTs to labour productivity growth due to capital deepening (%)



Source: Compiled from various ABS sources.

During the early 1990s, ICT capital deepening contributed an average 1.68 percentage points to labour productivity growth across those industries for which data are available. During the second half of the 1990s, ICTs contributed an average 5.89 percentage points. Put another way, ICTs contributed 33 per cent to the percentage point growth in

labour productivity due to capital deepening during the early 1990s, rising to 48 per cent during the second half of the decade.

In the United States, ICTs contributed 38 per cent to labour productivity growth between 1996 and 1999 – computer hardware alone contributed almost 24 per cent, and computer software contributed a further 10.5 per cent.

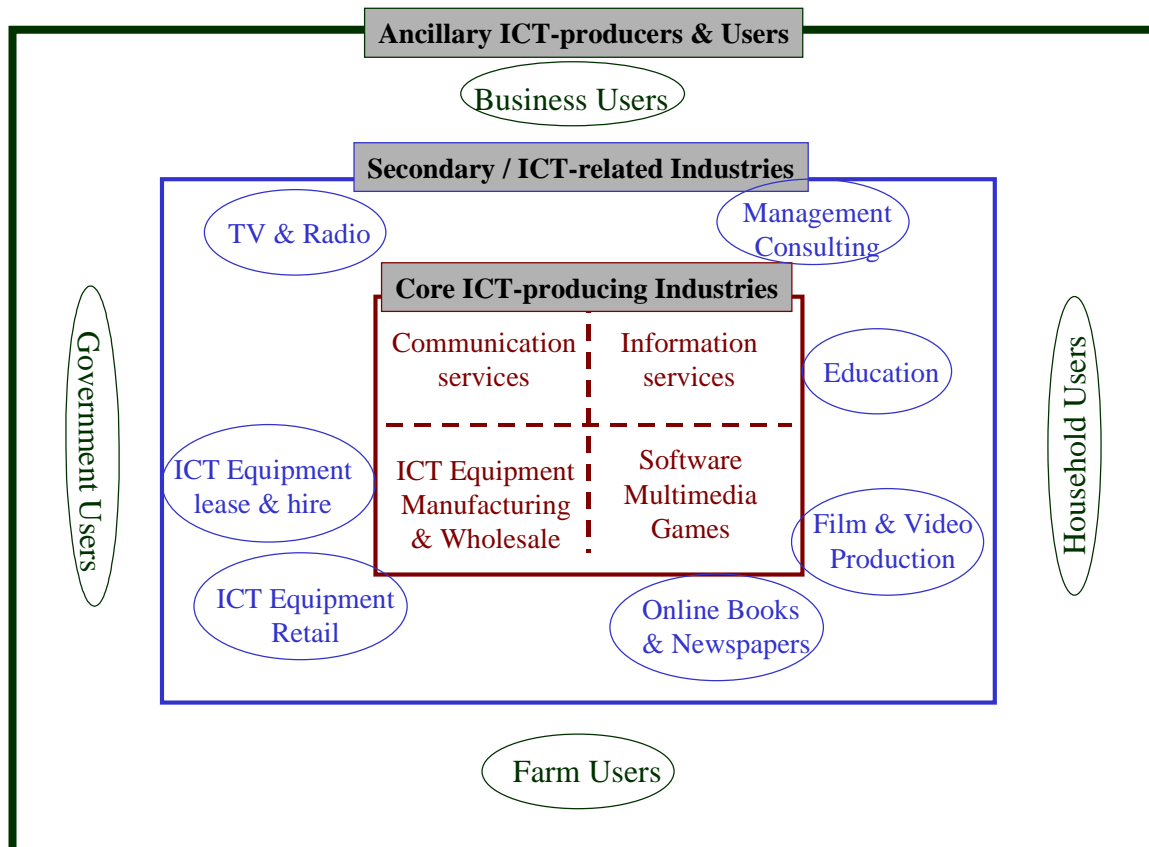
In Australia, computer hardware contributed 18 per cent and software 12 per cent of the average percentage point growth in labour productivity due to capital deepening in the 12 industries for which data are available.

ICTs have been making a very substantial contribution to the U.S. economy during the 1990s. The ICT-producing industries make a smaller direct contribution in Australia than in other developed countries, but evidence of the benefits of ICT investments and usage is now emerging.

ICTs in Australia

Information and Communication Technology (ICT) producing industries are large and rapidly growing, but it is the enabling impact of ICTs across the economy that promises most. This report looks at the impact of ICT activities in Australia.

Figure 5 ICT production and use



ICTs can be thought of a spanning three levels:

1. The core ICT-producing industries – including telecommunication and internet services, ICT equipment manufacturing, computing and related services, software and multimedia content (centre of diagram);
2. A range of secondary or ICT-related industries – including equipment leasing and hiring, TV program, film and video production, management consulting, ICT related education and training, TV and radio networks, etc; and
3. Ancillary ICT producers and users in industry, government and households throughout the economy.

This report examines the impact of ICT related activities in Australia at each of these levels.¹

The ICT Industries in Australia

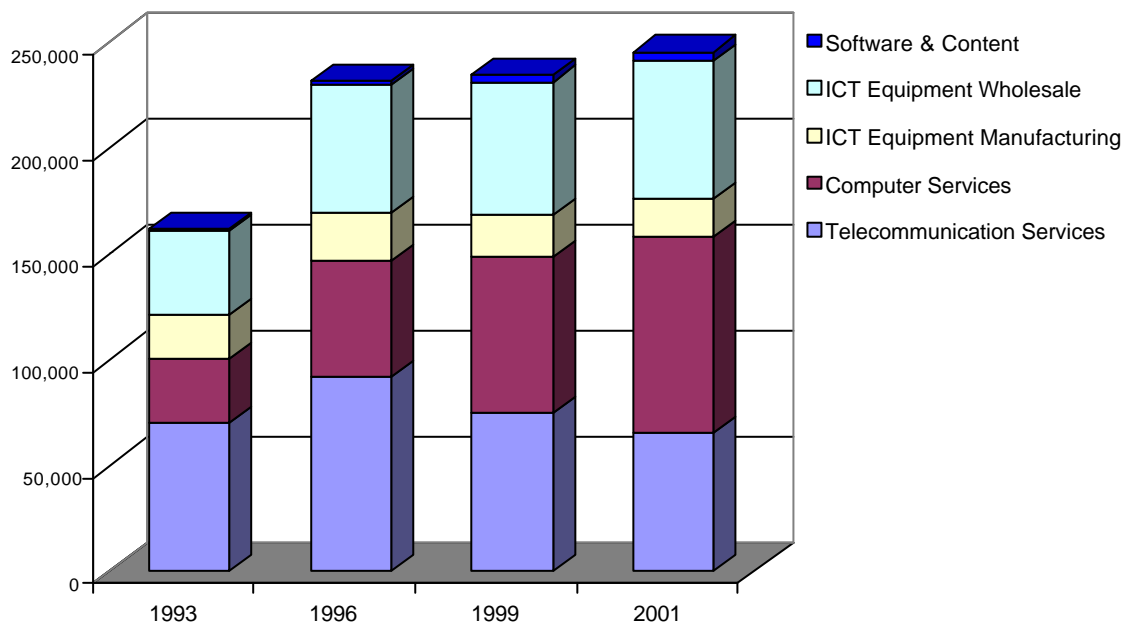
"The prodigious vitality of the digital economy is grounded in information technology (IT) producing industries – the firms that supply the goods and services that support IT-enabled business practices across the economy, as well as the Internet and e-commerce."²

The Australian ICT-producing industries are large and growing. They directly employ almost 240,000 Australians and earn around \$100 billion per annum.

Employment in the ICT-producing industries

In 1999, there were 234,600 Australians employed in the core ICT-producing industries, and we estimate that there will be at least 236,500 employed in the industries this year. The ICT-producing industries account for 2.7 per cent of Australia's total employment. Around 73,000 jobs have been created within the industries since 1993 – equivalent to 6.7 per cent of the total increase in jobs in Australia over the period.

Figure 6 Employment in the ICT-producing industries, 1993-2001 (jobs)



Note: 2001 estimated, based on growth since 1996.
Source: ABS, own analysis.

Computer services businesses employ almost 93,000 Australians, more than 90 per cent of which (84,800) are employed in computer consultancy. In 1999, telecommunications

services employed around 74,500 people, ICT equipment wholesalers employed around 63,000 and ICT equipment manufacturers employed just less than 20,000. Employment in computer services is growing by almost 12 per cent a year, with computer consultancy jobs increasing at an average annual rate of more than 15 per cent, or by more than 62,000 since 1993. Between 1993 and 1999, growth in computer consultancy jobs was equivalent to 3.8 per cent of total job growth in Australia.

Table 1 **Employment in the ICT-producing industries, 1993-2001**

	1993	1996	1999	2001 (Estimated)	Average annual growth 1996-99
	no	no	no	no	%
Telecommunication Services	70,273	91,701	74,467	65,429	-6.3
Computer Services	30,068	55,046	74,395	92,850	11.7
Data processing	2,049	5,291	7,174	8,977	11.9
Data store & retrieve	636	994	908	856	-2.9
Computer maintenance	4,778	5,032	2,519	1,750	-16.6
Computer consultancy	22,605	43,711	63,794	84,830	15.3
Manufacturing & Wholesale	60,613	83,025	82,677	82,446	-0.1
<i>ICT Equipment Manufacturing</i>	<i>20,943</i>	<i>22,629</i>	<i>19,517</i>	<i>17,769</i>	<i>-4.6</i>
Computer & business	1,988	6,025	2,915	1,998	-17.2
Telecoms & broadcast	8,285	7,429	6,583	6,093	-3.8
Electronic equip	5,681	3,746	7,734	14,197	35.5
Cable & wire	4,989	5,430	4,084	3,437	-8.3
<i>ICT Equipment Wholesale</i>	<i>39,670</i>	<i>60,396</i>	<i>63,160</i>	<i>65,102</i>	<i>1.5</i>
Computer Wholesale	15,922	26,599	27,212	27,632	0.8
Business machine & equip wsl	23,748	33,979	35,948	37,350	1.9
Software & Content	557	1,904	3,045	4,383	20.0
Recorded media mfg & publish	557	1,904	3,045	4,383	20.0
TOTAL	161,511	231,676	234,584	236,551	0.4

Notes: Includes specialist and secondary ICT producers. Mfg = manufacturing, Wsl = wholesaling, Equip = equipment.

Sources: ABS (various years) *Information Technology Australia*, 8126.0, Canberra; ABS (various years) *Computer Services Industry Australia*, 8669.0, Canberra; ABS (various years) *Telecommunications Services Australia*, 8145.0, Canberra; ABS (various years) *Manufacturing Industry Australia*, 8221.0, Canberra; ABS (various years) *Australia Now - A Statistical Profile*, Canberra. Own analysis.

However, employment is declining in some sub-sectors of the ICT-producing industries. Computer and business machine manufacturing, computer maintenance and telecommunications services have all experienced falling employment since the mid-1990s.

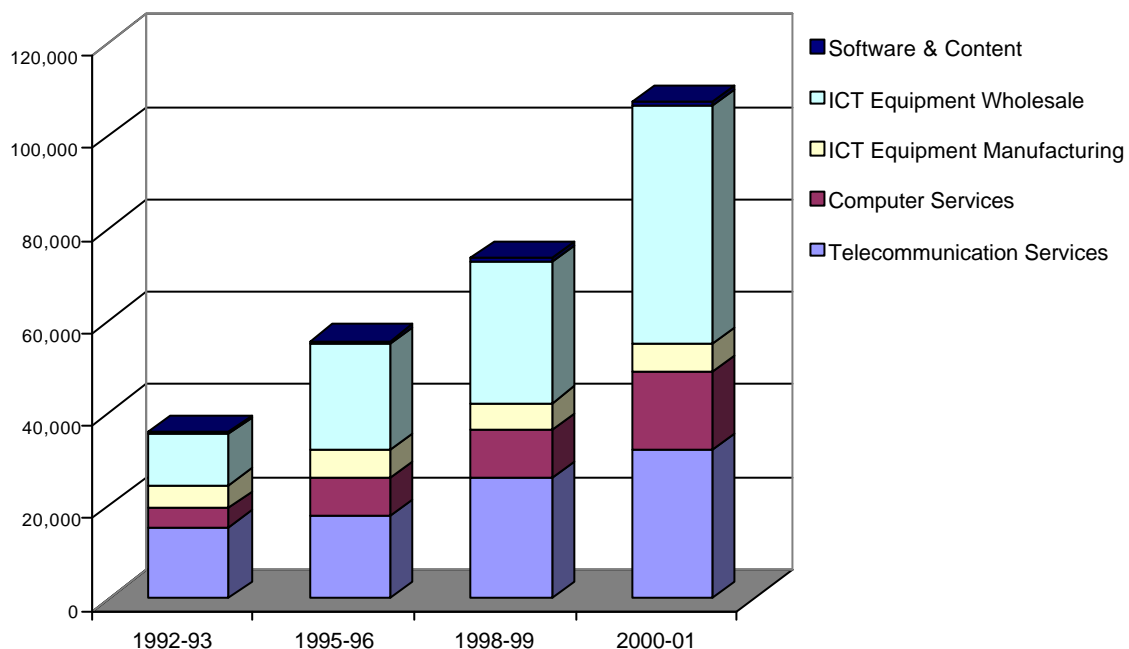
ICT industry jobs are higher paying than jobs in most other industries. In 1998-99, specialist ICT producers' wages and salaries paid were equivalent to \$51,243 per annum. By contrast, average wages and salaries per employee in Australia were just

\$29,409 – with wages and salaries per employee in the textile, clothing, footwear and leather industries just \$25,631 and in the automotive industries \$38,815. Wages and salaries in the ICT-producing industries are more than 1.7 times the national average.

ICT-producing industries' income

The core ICT-producing industries earned income approaching \$74 billion in 1998-99, and are expected to have earned as much as \$100 billion during 2000-01. ICT equipment wholesaling businesses accounted for almost half total industry income, telecommunication services income accounted for a further third, and computer services for around 16 per cent.

Figure 7 ICT-producing industries' income, 1992-93 to 2000-01 (\$m)



Note: 2000-01 estimated, based on growth between 1992-93 and 1998-99. Current prices.
Source: ABS. Own analysis.

ICT-producing industries' income grew at an annual average 17.5 per cent between 1992-93 and 1998-99.³ Among the fastest growing areas were computer consultancy services, which saw industry income increase at an average annual rate of almost 36 per cent. ICT equipment wholesaling and business machine and equipment wholesaling have also grown strongly, increasing industry income at average annual rates of 36 and 25 per cent, respectively.

Table 2 ICT-producing industries' income, 1992-93 to 2000-01 (\$m)

	1992-93	1995-96	1998-99	2000-01 (Estimated)	Average annual growth 1992-93 to 1998-99
	\$m	\$m	\$m	\$m	%
Telecommunication Services	15,577	17,961	26,083	32,277	11.2
Computer Services	4,101	7,977	10,474	16,603	25.9
Data processing	148	np	np	-	-
Data store & retrieve	104	np	100	99	-0.6
Computer maintenance	1,085	np	np	-	-
Computer consultancy	2,764	np	8,680	15,980	35.7
Manufacturing & Wholesale	15,868	29,198	36,328	53,620	21.5
<i>ICT Equipment Manufacturing</i>	<i>4,911</i>	<i>6,312</i>	<i>5,794</i>	<i>6,147</i>	<i>3.0</i>
Computer & business	895	1,935	1,274	1,461	7.1
Telecoms & broadcast	1,885	1,660	1,508	1,409	-3.3
Electronic equip	843	645	1,769	2,474	18.3
Cable & wire	1,287	2,016	307	234	-12.7
<i>ICT Equipment Wholesale</i>	<i>10,957</i>	<i>22,887</i>	<i>30,534</i>	<i>51,426</i>	<i>29.8</i>
Computer Wholesale	5,000	12,119	15,748	29,056	35.8
Business machine & equip wsl	5,957	10,767	14,786	22,991	24.7
Software & Content	386	611	698	899	13.5
Recorded media mfg & publish	386	611	698	899	13.5
TOTAL	35,931	55,748	73,583	101,530	17.5

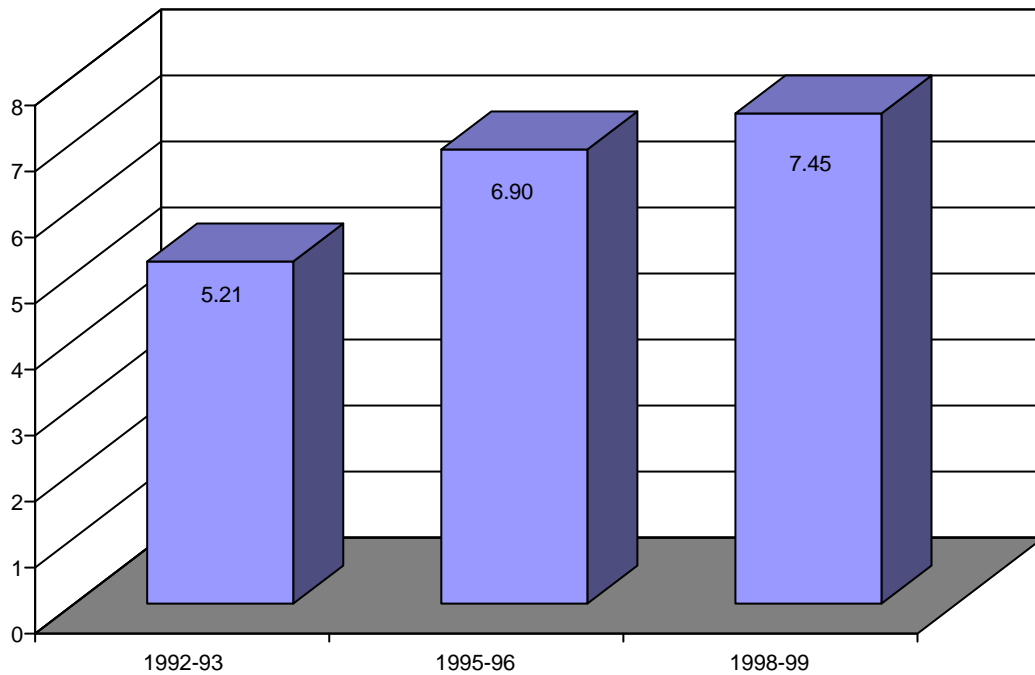
Notes: Includes specialist and secondary ICT producers. Mfg = manufacturing, Wsl = wholesaling, Equip = equipment, np = not published, - = not calculable.

Sources: ABS (various years) *Information Technology Australia*, 8126.0, Canberra; ABS (various years) *Computer Services Industry Australia*, 8669.0, Canberra; ABS (various years) *Telecommunications Services Australia*, 8145.0, Canberra; ABS (various years) *Manufacturing Industry*, 8221.0, Canberra; ABS (various years) *Australia Now - A Statistical Profile*, Canberra. Own analysis.

ICT-producing industries' contribution to GDI

The contribution of the ICT-producing industries to the Australian economy is increasing. In 1992-93, ICT industry income was the equivalent of 5.2 per cent of Gross Domestic Income (GDI). By 1998-99, it was equivalent to 7.5 per cent. Between 1992-93 and 1998-99, the increase in ICT-producing industry income was equivalent to 13 per cent of the increase in total gross domestic income, suggesting that the ICT industries are making a significant contribution to economic growth.

Figure 8 Ratio of ICT-producing industries' income to gross domestic income, 1992-93 to 1998-99 (%)



Note: Calculated as industry income from domestic production and exports share of gross domestic income in current prices.

Sources: ABS (various years) *Information Technology Australia*, 8126.0, Canberra; ABS (various years) *Manufacturing Industry*, 8221.0, Canberra; ABS (2000) *Australian System of National Accounts*, 1999-00, 5204.0, Canberra. Own analysis.

ICT Employment in Australia

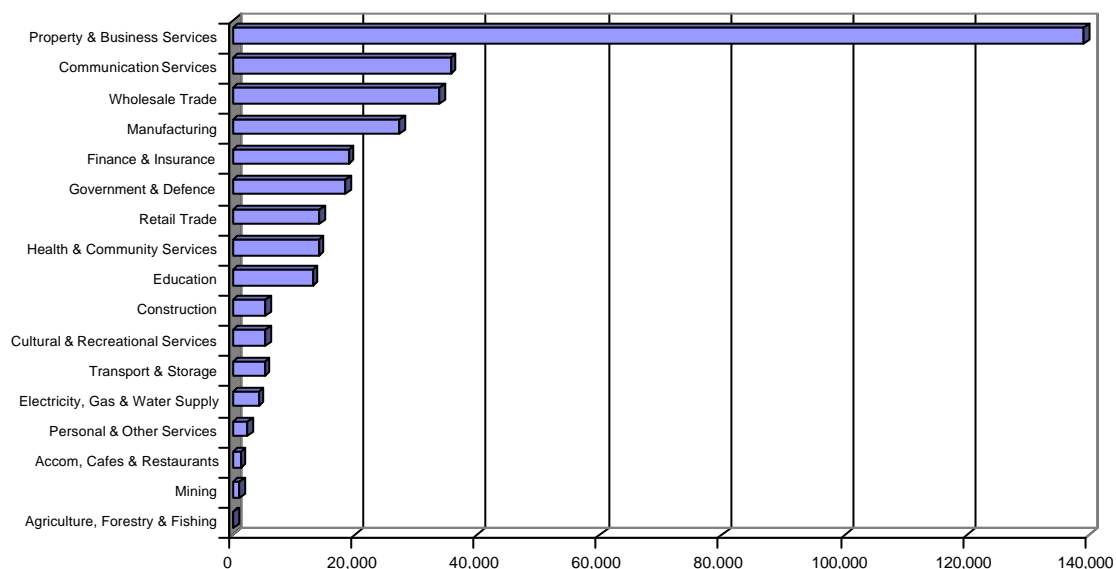
*"Information technology workers not only produce and maintain the Nation's computing and communications infrastructure, they also generate the knowledge, ideas and information critical to the development of the digital economy."*⁴

As many as 680,000 Australians work in ICT and related support jobs, depending upon ICTs for their livelihood.

ICT Jobs in Australia

During the November quarter 2000, there were 340,700 people employed in ICT jobs in Australia⁵ – up by 30 per cent from 263,800 (or by 76,900 jobs) in 1996. The number of ICT jobs in Australia has increased at a compound annual rate of 6.6 per cent since 1996. By contrast, employment in the Australian economy as a whole has increased at a compound annual 2.1 per cent.

Figure 9 ICT jobs by industry (November quarter 2000)

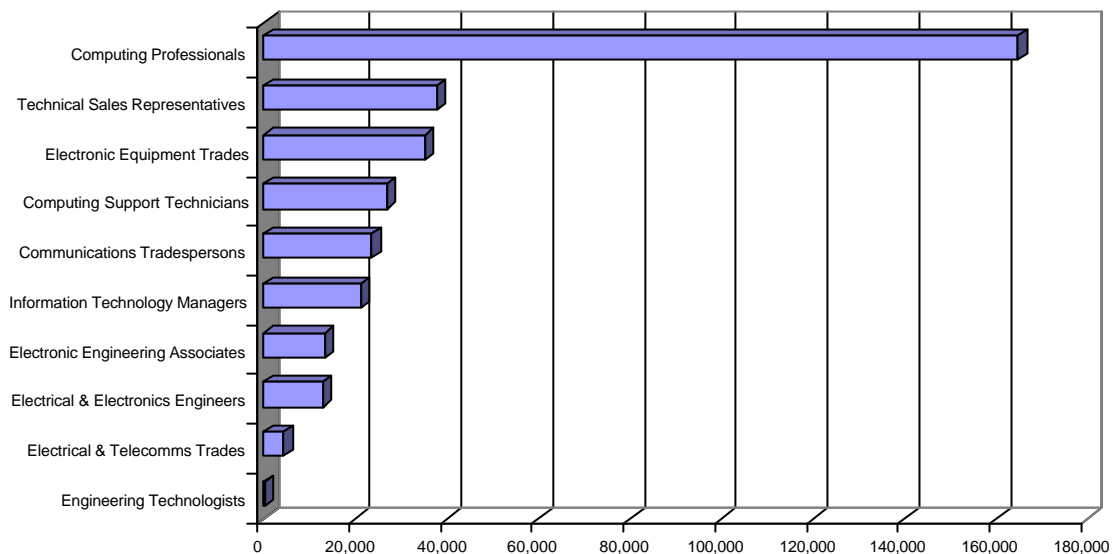


Source: ABS unpublished data. Own analysis.

In November 2000, almost 140,000 (41%) of all ICT jobs in Australia were in property and business services, 35,600 (10%) in communication services, 33,900 (10%) in the wholesale trade, and 27,400 (8%) in manufacturing. Growth in ICT jobs is particularly

strong in health and community services – with ICT jobs growing at a compound annual rate of 47 per cent between 1996 and 2000. In the accommodation, cafes and restaurants sector, ICT jobs increased at a compound annual rate of 44 per cent over the same period. ICT jobs in property and business services increased at a compound annual rate of more than 21 per cent, in finance and insurance at a compound annual 11 per cent, and in education 8 per cent.

Figure 10 **ICT jobs by occupation (November quarter 2000)**



Source: ABS unpublished data. Own analysis.

In November 2000, there were 165,000 computer professionals employed in Australia, 37,700 technical sales representatives, 26,900 computer support technicians, 23,600 communications tradespersons, and 21,200 information technology managers. Job growth has been fastest among IT managers, with jobs having increased at a compound annual rate of more than 16 per cent since 1996. Computing professionals' jobs have increased at a compound annual 12.3 per cent since 1996, technical sales representatives jobs at a compound annual 11.4 per cent, and electronic and office equipment tradespersons jobs at a compound annual 6.6 per cent. These rates of increase suggest two things. First, strong job growth in ICTs. Second, a shift towards higher paid professional jobs.

Table 3 ICT jobs in Australia by industry and occupation, November 2000

	Information Technology Managers	Electrical and Electronics Engineers	Engineering Technologists	Technical Sales Representatives	Computing Professionals	Electronic Engineering Associate Professionals	Computing Support Technicians	Electronic and Office Equipment Tradespersons	Comms Tradespersons	Electrical and Telecomms Trades Assistants	Total ICT jobs
Agriculture, Forestry & Fishing	200	0	0	0	0	0	0	0	0	0	200
Mining	0	0	0	0	800	0	300	0	0	0	1,100
Manufacturing	900	300	0	7,100	8,300	3,100	2,200	3,000	1,300	1,200	27,400
Electricity, Gas & Water Supply	0	0	0	500	2,300	0	0	700	0	800	4,300
Construction	0	0	0	0	600	300	0	1,700	1,400	1,500	5,500
Wholesale Trade	1,700	0	0	16,600	4,400	1,700	1,100	8,100	0	300	33,900
Retail Trade	400	0	0	2,600	4,000	1,100	600	4,600	1,000	0	14,300
Accom, Cafes & Restaurants	0	0	0	0	700	0	300	300	0	0	1,300
Transport & Storage	400	0	0	300	3,200	200	500	700	0	0	5,300
Communication Services	1,200	0	300	2,600	5,800	2,400	2,200	1,100	19,800	200	35,600
Finance & Insurance	2,000	0	0	0	12,400	200	3,000	1,400	0	0	19,000
Property & Business Services	9,800	1,500	0	7,800	98,500	1,700	9,700	9,900	100	200	139,200
Government & Defence	2,900	200	0	0	11,200	900	3,100	200	0	0	18,500
Education	800	2,100	0	0	5,900	300	2,000	2,000	0	0	13,100
Health & Community Services	0	9,000	0	0	2,800	700	1,000	400	0	200	14,100
Cultural & Recreational Services	1,000	0	0	0	2,300	800	300	1,000	0	0	5,400
Personal and Other Services	0	0	0	300	1,600	100	500	0	0	0	2,500
Total	21,200	13,100	300	37,700	164,900	13,200	26,900	35,100	23,600	4,400	340,700

Note: Due to the highly disaggregated nature of these data, many of the cells in this table will have a Relative Standard Error (RSE) of 25% or more and should therefore be used with caution.

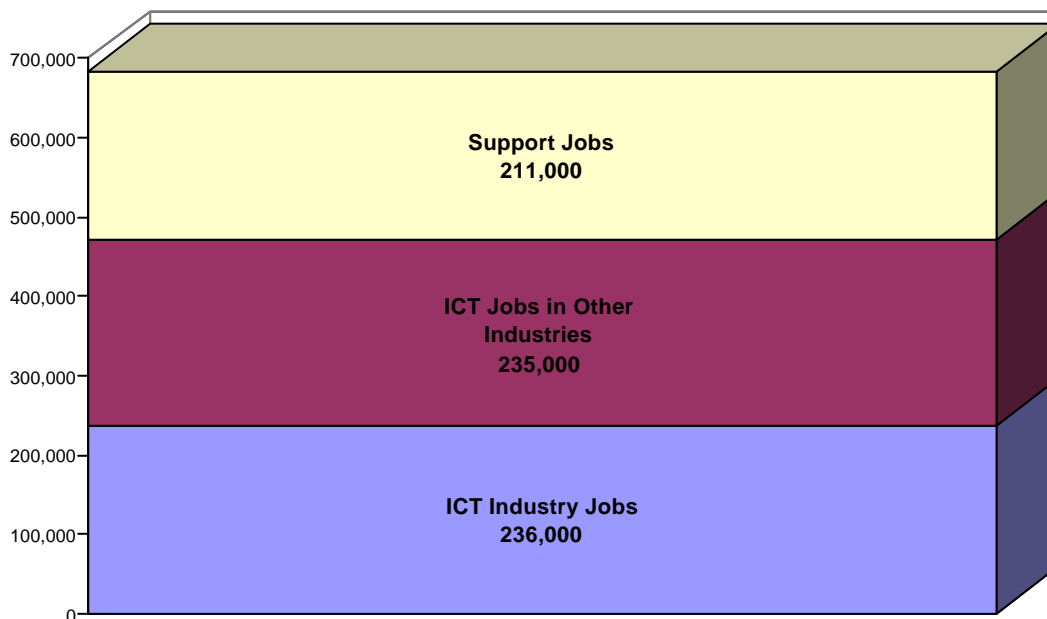
Source: ABS Unpublished data. Own analysis.

Total ICT and related employment

Putting direct ICT-producing industry jobs and ICT jobs in other industries together, there are around 472,000 Australians employed in ICTs.⁶ By comparison, during 1999-2000, there were:

- 438,000 employed in agriculture;
- 86,000 employed in the textiles, clothing footwear and leather industries;
- 82,000 employed in the chemicals and plastics industries;
- 78,000 employed in the mining industries;
- 65,000 employed in the electricity, gas and water supply industries;
- 51,500 employed in automotive manufacturing;
- 14,000 employed in the pharmaceuticals manufacturing industry; and
- 12,000 employed in aerospace.⁷

Figure 11 How ICT jobs in Australia stack up



Source: ABS, own analysis.

Moreover, each ICT job must be supported by a range of administrative and other activities. It is impossible to calculate with accuracy how many such jobs there are, but one way to generate a 'ballpark' estimate is to use the proportion of other support jobs to ICT professional jobs in the core ICT-producing industries. In the ICT industries there

were approximately 0.9 support jobs to every ICT professional job in 1999. Hence, there could easily be 211,000 ICT support jobs in other industries in Australia.

And there are many more around the fringes that are not counted in these data. Industries very closely related to the core ICT-producing industries are significant employers. For example:

- radio and television broadcasting employs around 14,000 and film and video production employs a further 9,500;
- there are an estimated 200,000 people employed in telecommunications call centres, with an estimated 14 per cent growth in the number of 'seats' this year;⁸
- there are 1,200 to 1,500 ICT-related academics in Australian universities, and many hundreds of teachers teaching ICT-related skills and courses in our schools; and
- there are many thousands of workers in construction-related jobs working on building and maintaining Australia's communications infrastructure – Leighton's alone earns 10 per cent of its total revenues from telecommunications network roll-outs,⁹ implying that it alone employs more than 1,000 people in network construction jobs.

Ignoring this 'fringe' employment, and simply adding ICT industry jobs, ICT jobs in other industries and estimated ICT support jobs in other industries, suggests that there are at least 683,000 Australians depending directly upon ICTs for their employment.

Expenditure on ICTs in Australia

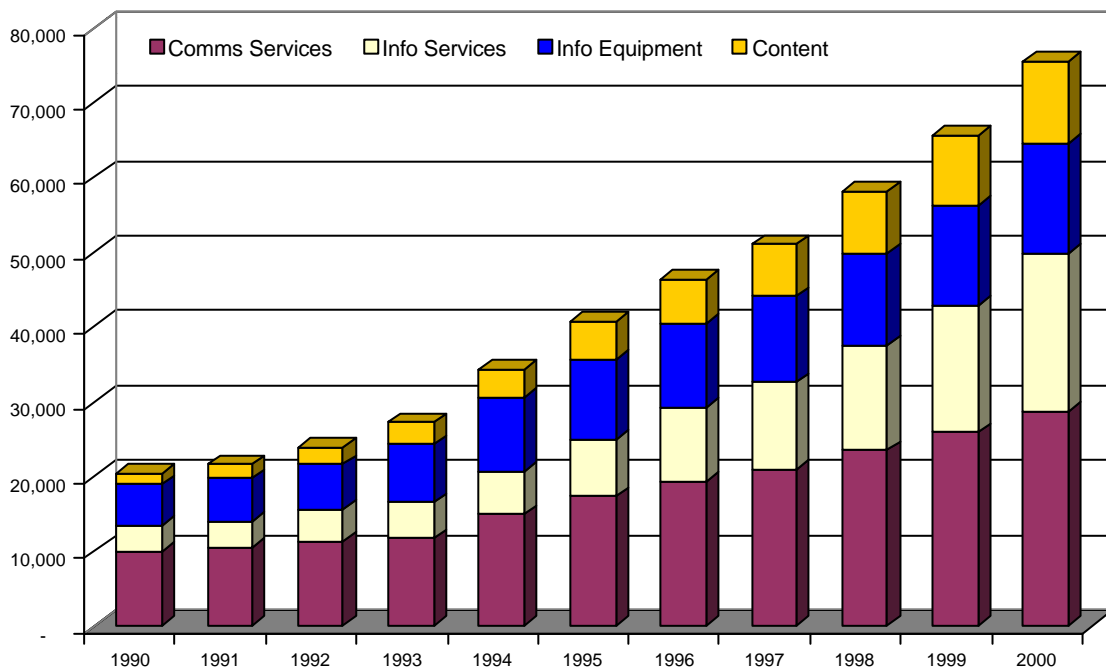
"New investments in IT are helping to generate higher rates of U.S. labor productivity growth."¹⁰

Australians are amongst the most intensive users of ICTs in the world, spending some \$US 1,906 per head of population on ICTs in 1999.¹¹

Australian market expenditure on ICTs

*Information Industries Update 2001*¹² presented two views of Australian ICT market expenditures – an industry view derived from ABS industry survey data, and a commodity view based on detailed estimates of expenditures on a wide range of ICT products and services.¹³

Figure 12 Composition of Australian ICT expenditures (commodity view), 1990 to 2000 (\$m)



Note: 2000 estimated. All values are in current prices. The content segment includes items not included in the definition adopted in this report.

Source: ICT Map compiled by John Houghton from various sources.

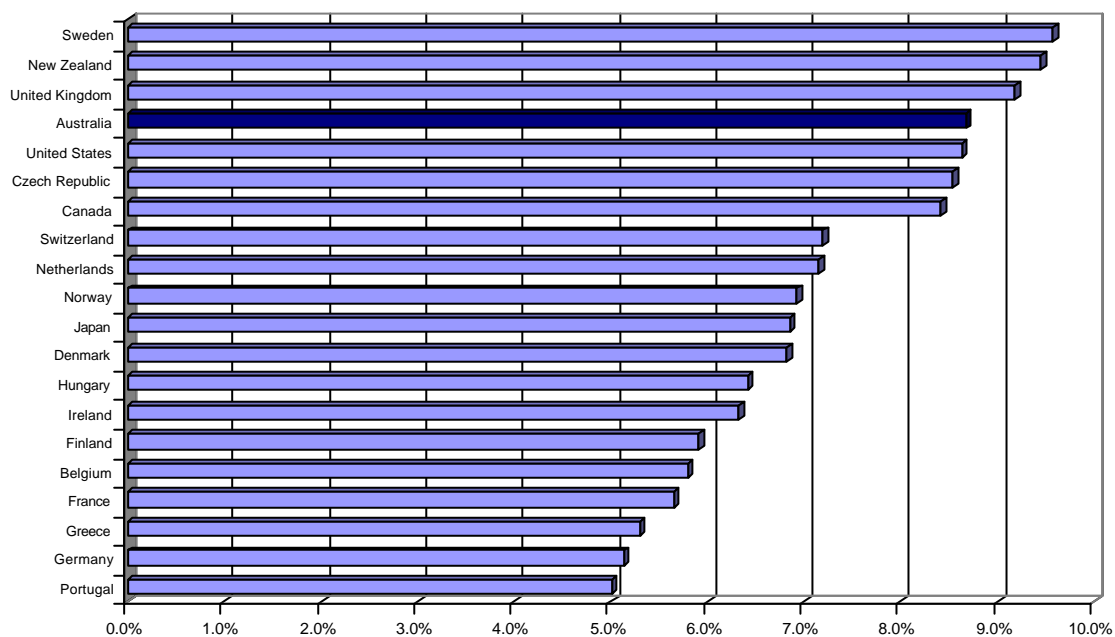
The industry view suggested that total ICT expenditure in Australia reached \$61.5 billion in 1998-99, up from just under \$25 billion in 1992-93. The commodity view suggested that Australian expenditure on ICT products and services amounted to more

than \$65 billion in 1999. During 1999, expenditure on communication services accounted for the largest share at just under \$26 billion (39%), information services expenditure reached \$17 billion (26%), and ICT equipment expenditure \$13 billion (20%).

Comparative market and internal ICT expenditures

In 1999, Australia ranked 4th among OECD countries in terms of the ratio of ICT expenditure to Gross Domestic Product (GDP) – behind Sweden, New Zealand and the United Kingdom. Australians spent the equivalent of 7.2 per cent of GDP on ICTs in 1992, rising to 8.7 per cent in 1999. This put Australia ahead of the United States, which spent 8.6 per cent of GDP on ICTs. Worldwide ICT expenditure amounted to 6.5 per cent of global product in 1999, up from 5.6 per cent in 1992.¹⁴

Figure 13 Ratio of ICT expenditure to Gross Domestic Product, 1999



Source: World Information Technology and Services Alliance (2000) *Digital Planet 2000: The Global Information Economy*, WITSA.

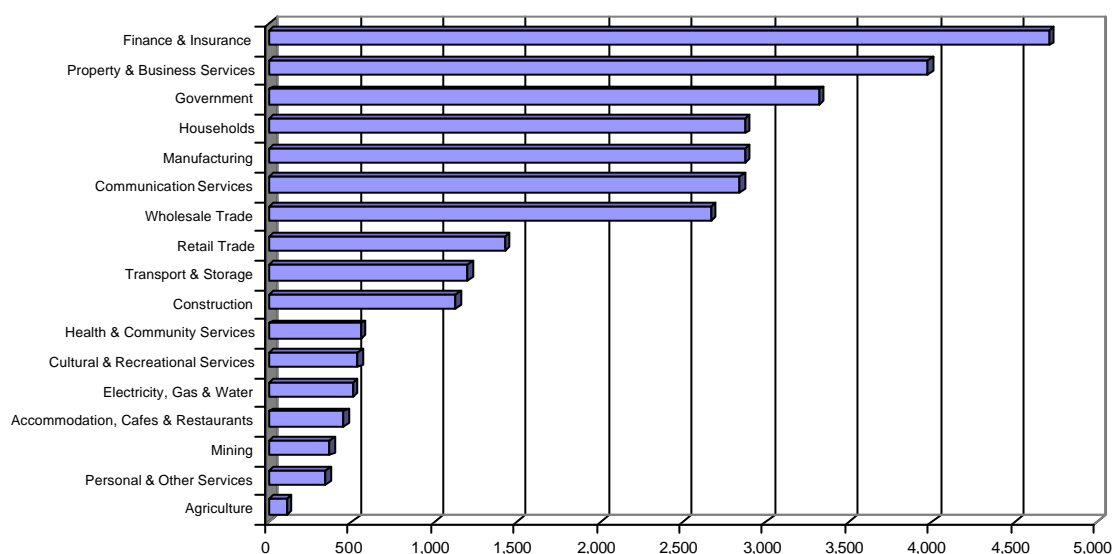
In terms of ICT spending per capita, Australia ranked 10th in 1999 – spending \$US 1,906 per capita. This compares to Switzerland's \$US 3,212 per capita, the United States' \$US 2,711 and the United Kingdom's \$US 1,943.¹⁵ Clearly, on any measure, Australians are among the most intensive users on ICTs in the world.

Sectoral expenditures on ICTs

An alternative way to examine expenditure on ICTs is to explore incomplete Australian Bureau of Statistics data on the level and sectoral composition of ICT expenditure in Australia. These data cover business use of IT, government use of IT, use of IT on farms and in households. Unfortunately, there are no detailed data on ICT expenditures in education. Moreover, these data refer to identifiable expenditure on IT only – excluding communications, content and many consumables. Hence, they are *underestimates*.

Circa 1997-98, those sectors of the economy for which data are available spent more than \$33 billion on ICTs and their use. The largest sectoral expenditures were recorded by finance and insurance with \$4.7 billion, property and business services with \$4 billion, government with \$3.3 billion, manufacturing industries, communications services and households, all with around \$2.8 billion, and wholesale trade businesses with \$2.7 billion.

Figure 14 ICT expenditure by industry sector, 1997-98 (\$m)



Sources: ABS (various years) *Business Use of Information Technology Australia*, 8129.0, Canberra; ABS (various years) *Household use of Information Technology Australia*, 8128.0, Canberra; ABS (various years) *Government Use of Information Technology Australia*, 8119.0, Canberra; ABS (various years) *Use of Information Technology on Farms Australia*, 8150.0, Canberra; ABS (various years) *Use of Internet by Households Australia*, 8147.0, Canberra. Own analysis.

That ICT employment and investment is high in the finance and insurance, and business services industries shows how important ICTs are underpinning activities across the

economy – both directly, in these industries, and in all the other industries that use banking and business services.

Table 4 ICT expenditure by industry, 1997-98 (\$m)

<i>Sector</i>	<i>Expenditure on ICT wages & salaries</i>	<i>Other ICT expenditure</i>	<i>Total ICT expenditure</i>
	<i>\$m</i>	<i>\$m</i>	<i>\$m</i>
Agriculture (Farms) ^(b)	na	na	107
Mining	61	306	367
Manufacturing	585	2,289	2,873
Electricity, Gas & Water	86	419	505
Construction	69	1,058	1,127
Wholesale Trade	559	2,107	2,666
Retail Trade	160	1,263	1,423
Accommodation, Cafes & Restaurants	79	379	454
Transport & Storage	193	1,011	1,204
Communication Services	259	2,581	2,840
Finance & Insurance	957	3,752	4,709
Property & Business Services	678	3,298	3,977
Health & Community Services	93	461	554
Cultural & Recreational Services	97	439	536
Personal & Other Services	67	277	344
Education	na	na	na
Government	788	2,529	3,317
Federal	381	1,043	1,424
State	284	1,085	1,369
Local	77	269	346
Other Government	45	133	178
Households ^(a)	na	2,875	2,875
Total	5,518	27,574	33,195

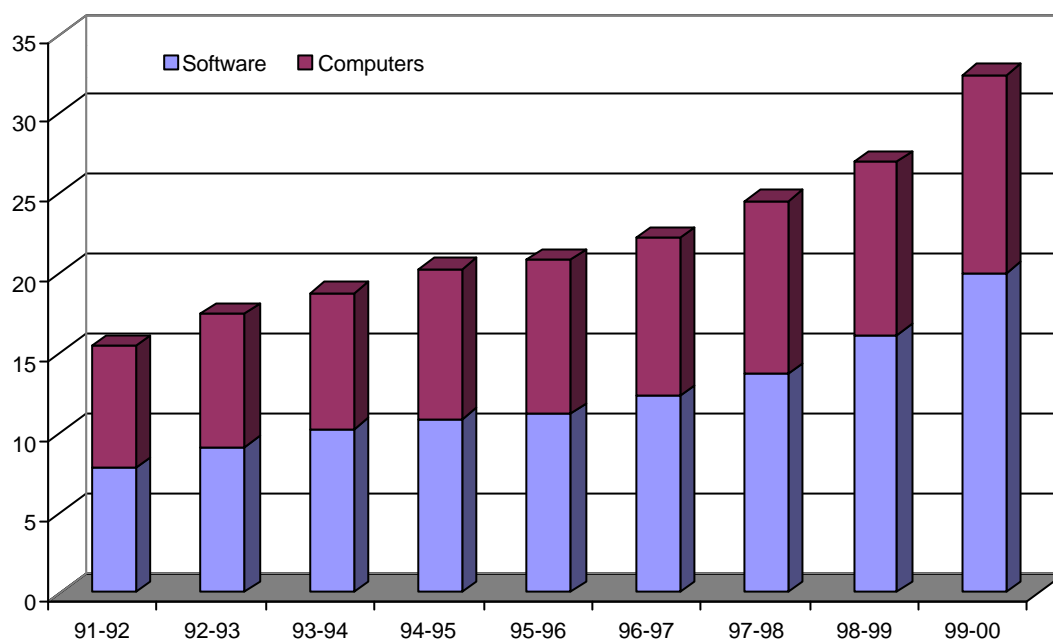
Notes: (a) 12 months to Feb 1996. (b) Estimated as per household expenditure times the number of farms using a computer as at March 1999. Na = not available.

Sources: ABS (various years) *Business Use of Information Technology Australia*, 8129.0, Canberra; ABS (various years) *Household use of Information Technology Australia*, 8128.0, Canberra; ABS (various years) *Government Use of Information Technology Australia*, 8119.0, Canberra; ABS (various years) *Use of Information Technology on Farms Australia*, 8150.0, Canberra; ABS (various years) *Use of Internet by Households Australia*, 8147.0, Canberra. Own analysis.

Capital investment in ICTs

Productivity gains throughout the economy are being driven by investment in ICT capital. ICTs are accounting for an increasing share of capital investment in many sectors of the economy. Computer software increased its share of total fixed assets from 0.7 per cent in 1991-92 to 1.2 per cent by 1999-00 – with software assets worth \$7.8 billion in 1991-92, rising to \$20 billion by 1999-00. The capital stock of computer hardware has risen from \$7.6 billion to \$12.4 billion over the same period, while that of communications and other electronic and electrical equipment increased from \$34 to \$47 billion.

Figure 15 ICTs share of total fixed assets, 1991-92 to 1999-00 (%)



Source: ABS (2000) *Australian System of National Accounts 1999-2000*, 5204.0, Canberra and unpublished working estimates provided by the ABS. Own analysis.

Table 5 ICTs share of total fixed assets – all sectors, 1991-92 to 1999-00 (\$bn)

	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00
Software	7.8	9.1	10.2	10.9	11.2	12.3	13.7	16.1	20.0
Computers	7.6	8.3	8.6	9.4	9.6	9.9	10.8	10.9	12.4
Comms & electronic	33.8	35.0	35.2	36.1	36.9	38.1	40.6	42.4	46.8
Total ICT	49.2	52.4	54.0	56.4	57.8	60.3	65.1	69.4	79.2
Total fixed assets	1,171	1,211	1,259	1,320	1,368	1,418	1,493	1,585	1,670
ICT Share (%)	4.2	4.3	4.3	4.3	4.2	4.3	4.4	4.4	4.7

Source: ABS (2000) *Australian System of National Accounts 1999-2000*, 5204.0, Canberra and unpublished working estimates provided by the ABS. Own analysis.

The benefits of ICTs

"...the contribution of computer hardware to productivity growth has been extraordinarily large."¹⁶

The key question is whether, and to what extent, this ICT-related investment brings benefits for Australians. It is also one of the most difficult questions to answer. Nevertheless, there is increasing evidence to suggest that ICT investments are paying off. In this chapter we explore overseas evidence on the impact of ICTs, then turn our attention to the economic impact of ICTs in Australia.

What are we looking for?

Assessments of the economic impact ICTs take various forms. Those looking at aggregate level impacts focus on the contribution of ICTs to economic growth and productivity. Others study impacts at the industry or sector level, looking at which industries benefit most, and how. Still others focus on firm level impacts, looking at cost savings, organisational changes, productivity and competitiveness.

At the aggregate level (of the national economy) ICTs can influence growth and productivity in various ways.¹⁷ First, *the direct impact of the ICT industries themselves*. Although the ICT industries make up only a relatively small share of total national value-added in most countries, their contribution to growth in real output can be significant if they are growing faster than other sectors of the economy.

Second, *the impact of ICTs as a capital good* used to facilitate production in all industries across the economy. ICTs are an increasingly important element and larger share of capital investment in many industries – driven by rapid technological development and price declines (measured as price-performance). Hence, ICTs are contributing more and more to output and labour productivity growth.

Third, *spillovers from ICT usage*. It is widely argued that, through network externalities, ICTs produce benefits that flow beyond those investing in them – in the same way that the some of the benefits of R&D flow beyond those investing in, and conducting it. There are, for example, obvious general and social welfare benefits of a well developed telecommunications network that are not captured by those investing in that network.

Overseas evidence of the contribution of ICTs

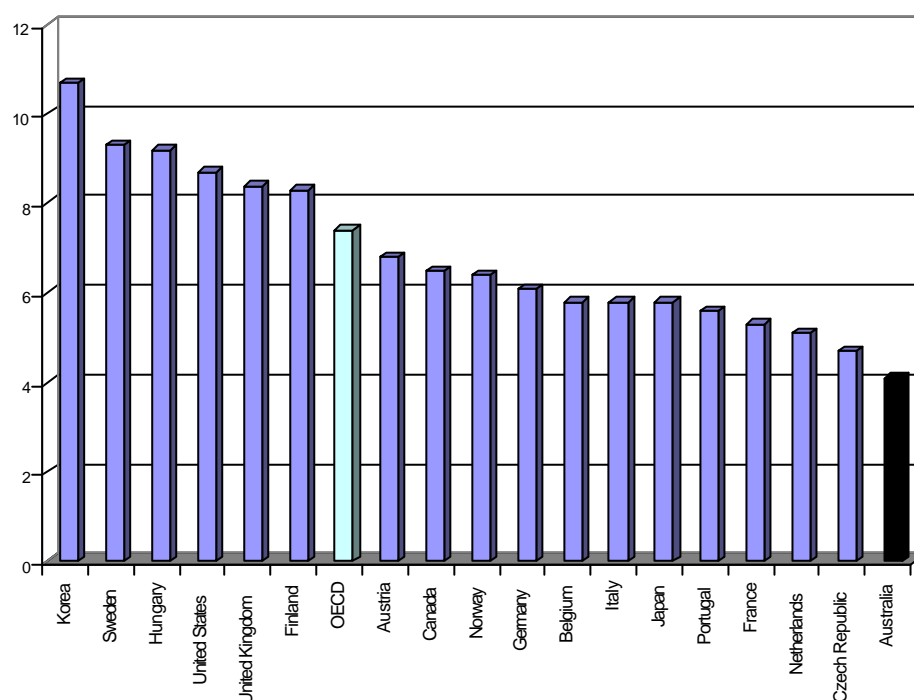
Exploring overseas evidence of the direct economic impacts of the ICT industries, the contribution of ICTs to national economies at the aggregate level, and more varied evidence on industry and firm level impacts shows that the economic contribution of ICTs is indeed significant.

Direct impacts of the ICT-producing industries

The OECD recently reported on the direct impacts of the ICT-producing industries on national economies in terms of their contribution to business sector value-added and employment.¹⁸ What their analysis shows is that, while large by national standards, Australia's ICT industries are a relatively small part of the economy by OECD standards. Consequently, the Australian ICT industries are contributing less to the Australian economy than they could be with further development.

In Australia, the ICT-producing industries contributed just 4.1 per cent of business sector value-added circa 1998. This compares with an OECD economy average of 7.4 per cent, and the United States' 8.7 per cent. The Australian ICT-producing industries contribute less than half to the Australian economy what they contribute in Korea, Sweden, Hungary, the United States, the United Kingdom and Finland.

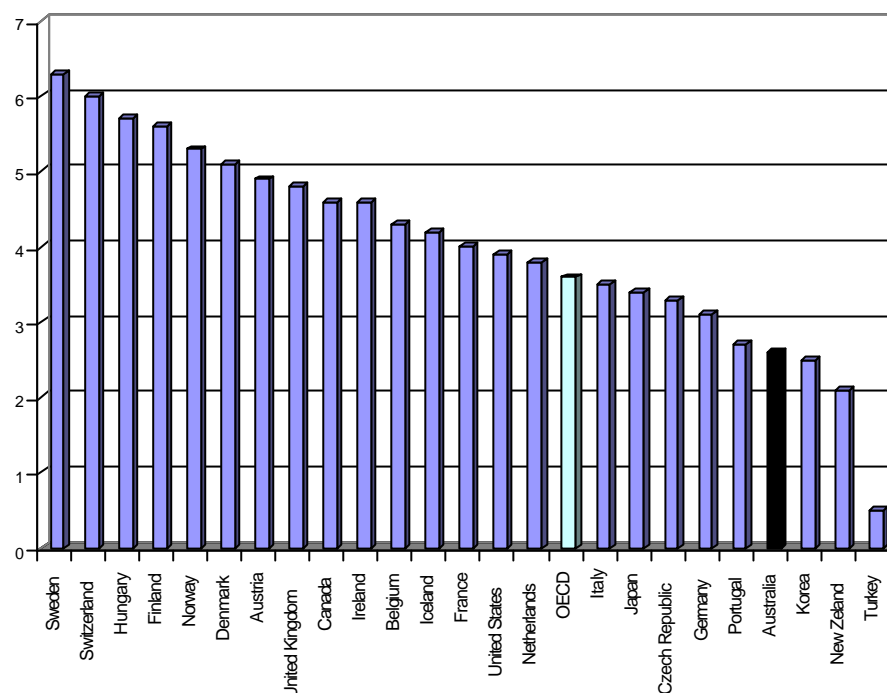
Figure 16 Share of ICT industries value added in total business sector value added in OECD countries, circa 1998 (%)



Source: OECD (2000) *Measuring the ICT Sector*, OECD, Paris.

The share of information industries employment in total business employment in Australia is also small by the standards of other OECD economies. In Australia, the information industries accounted for just 2.6 per cent of total business sector jobs, compared to an OECD average of 3.6 per cent and Sweden's 6.3 per cent.

Figure 17 Share of ICT industries employment in total business sector employment in OECD countries, circa 1998 (%)



Source: OECD (2000) *Measuring the ICT Sector*, OECD, Paris.

Clearly, the ICT-producing industries play a smaller role in the Australian economy than they do in most other developed countries. As a result, Australia is missing out on much of the contribution to output, employment and productivity that ICT-producing industries make in other economies.

Aggregate economic impacts of ICTs

A recent OECD study examining the contribution of ICTs to growth found that technological change had led to rapid improvement in the price-performance ratio of ICT capital goods, reducing the user cost of ICT capital relative to other types of assets, and leading to substitution of ICT capital for other capital goods, increased ICT investment and usage. It concluded that:

*"the contribution of ICT capital to output and labour productivity has been significant and rising in relative terms. In Canada, the United Kingdom and the United States, ICT equipment contributed about half of fixed capital's contribution to output growth. In France, Germany and Japan its contribution has been somewhat smaller."*¹⁹

However, this study looked only at IT hardware investments. Clearly, had software and communications been included, the impact of ICTs would likely have appeared significantly higher.

Recent evidence from the United States shows an acceleration of (multifactor) productivity growth during the late 1990s.²⁰ Jorgenson and Stiroh, among others, show that technological progress, particularly the rapid advances in semiconductor technology, and capital deepening, are the main factors behind this acceleration.²¹ It is also increasingly evident that the rise in (multifactor) productivity growth is no longer limited to the ICT-producing industries – implying that the benefits of *using* ICTs are spilling over to other industries.

Table 6 The contribution of IT hardware investments to output growth in G7 countries (%)

	Canada	France	Western Germany	Italy	Japan	United Kingdom	United States
Growth of output:							
1980-85	2.8	1.7	1.4	1.4	3.5	2.1	3.4
1985-90	2.9	3.2	3.6	3	4.9	3.9	3.2
1990-96	1.7	0.9	1.8	1.2	1.8	2.1	3.0
Contributions from:							
<i>ICT equipment</i>							
1980-85	0.25	0.17	0.12	0.13	0.11	0.16	0.28
1985-90	0.31	0.23	0.17	0.18	0.17	0.27	0.34
1990-96	0.28	0.17	0.19	0.21	0.19	0.29	0.42
<i>Total capital</i>							
1980-85	1.3	1.0	1.0	0.9	0.8	0.8	1.1
1985-90	1.1	1.3	1.2	0.9	1.3	1.1	1.0
1990-96	0.7	1.0	1.0	0.7	1.0	0.8	0.9

Note: based on a harmonised ICT price index.

Source: Schreyer, P. (2000) *The Contribution of Information and Communication Technology to Output Growth: A Study of the G7 Countries*, STI Working Paper 2000/2, OECD, Paris, p18.

A review of recent international studies by the OECD²² reported that:

- IT makes a smaller contribution to growth in Japan than in the United States;²³
- the impact on labour productivity growth of IT investment and international R&D spillovers linked to imported IT equipment in Canada is large;²⁴
- ICTs have contributed to output growth in France, and are expected to contribute a further 2.2 per cent to GDP growth over the next 10 years;²⁵
- the equipment industry in Finland (including Nokia) contributed 0.75 per cent to annual GDP growth between 1995 and 1999, rising to 1.2 per cent in 1999;²⁶ and
- the Bank of Korea suggest that 40 per cent of recent GDP growth in Korea came from the ICT industries.²⁷

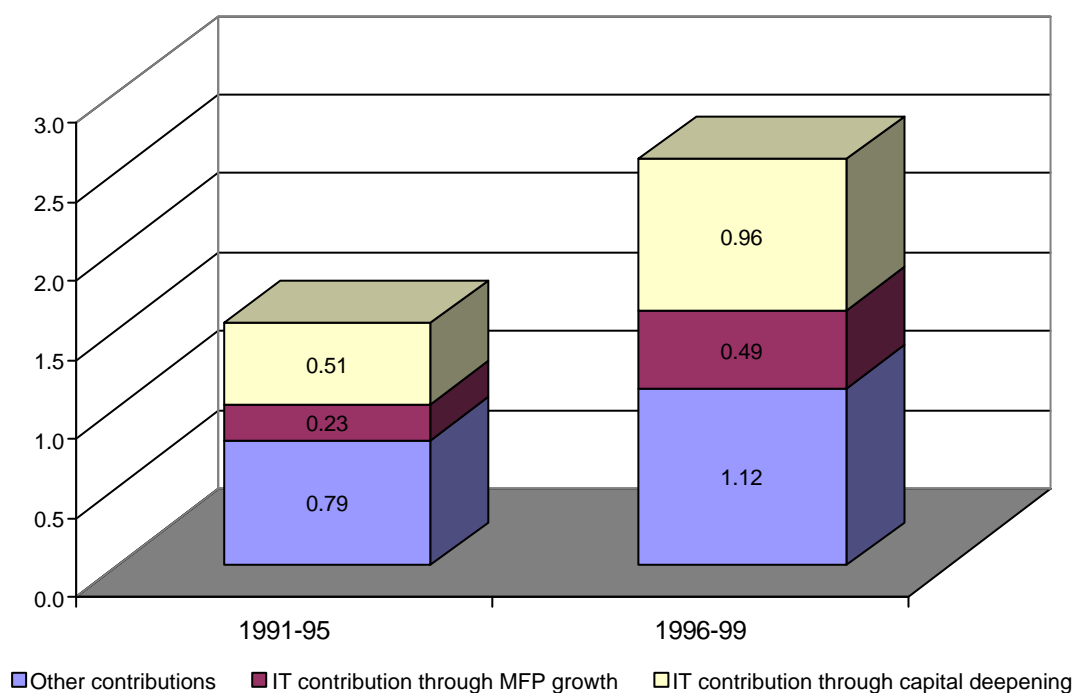
The U.S. Department of Commerce go somewhat further in their annual *Digital Economy* report,²⁸ showing that in the United States the IT-producing industries' share of national output increased from 6.3 per cent in 1994 to 8.3 per cent in 2000. The U.S. ICT-producing industries accounted for 30 per cent of total real economic growth

between 1995 and 1999, and for 31.5 per cent of total U.S. business expenditure on R&D in 1998. Moreover, falling prices for ICT goods and services directly reduced overall U.S. inflation by around 0.5 percentage points a year between 1995 and 1998, and contributed significantly to declining inflation in other industries. Real business investment spending on IT equipment and software more than doubled between 1995 and 1999.

The U.S. Department of Commerce recently concluded that:

*"[Stiroh] found strong labor productivity, as well as multifactor productivity gains in the computer-producing sector, implying that this sector positively contributes to overall productivity growth. Estimates by the Bureau of Labor Statistics (BLS) confirm Stiroh's finding that IT-producing industries make an outstanding contribution to multifactor productivity growth."*²⁹

Figure 18 Average annual percentage point contributions of IT to rising labour productivity growth in the United States



Source: Oliner, S.D. & Sichel, D.E. (2000) 'The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?,' Federal Reserve Board, Washington DC; reported in U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000.

It is also now clear that the use of ICTs is contributing to productivity improvements in the United States. The quality adjusted price for computer hardware in the U.S. fell 14 per cent a year during the first half of the 1990s, and 29 per cent a year between 1996 and 1998. While smaller, price declines for software and communications have also been substantial. Consequently, businesses have invested heavily in ICTs. And this IT

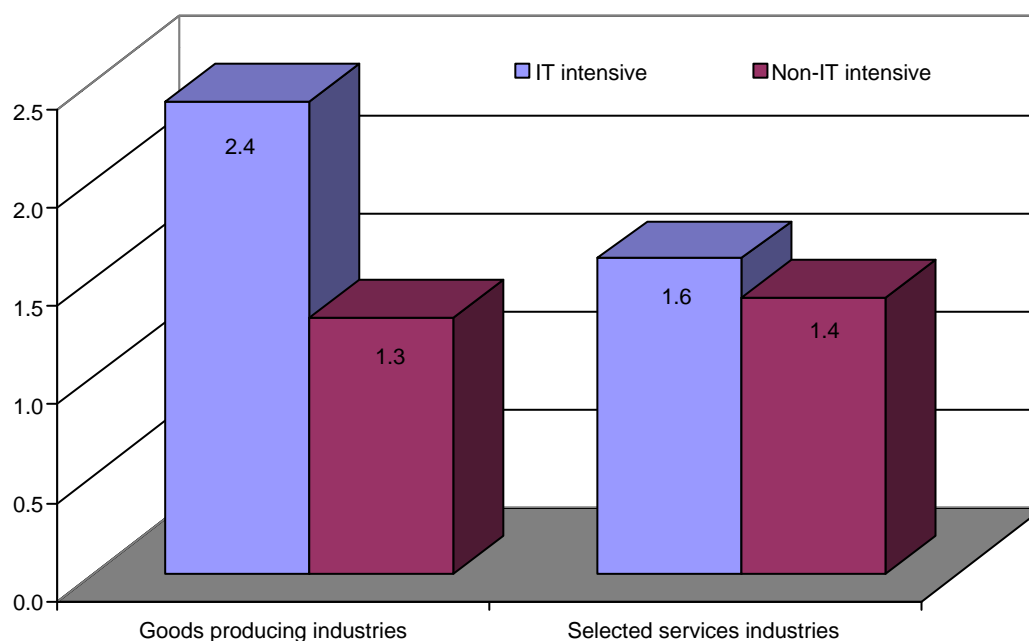
capital deepening accounts for a large and increasing share of the U.S. economy's rising productivity gains.³⁰

IT capital deepening contributed one-third (0.51 percentage points) to labour productivity growth in the U.S. between 1991 and 1995, and more than 37 per cent (0.96 percentage points) between 1996 and 1999. Multifactor productivity growth in the IT-producing industries contributed a further 15 per cent (0.23 percentage points) to productivity growth in the U.S. between 1991 and 1995, and 19 per cent (0.49 percentage points) between 1995 and 1999. Computer hardware alone contributed almost 24 per cent of labour productivity growth in the U.S. between 1996 and 1999, computer software contributed a further 10.5 per cent and communications equipment another 3.9 per cent.³¹

Industry and firm level impacts

Difficulties measuring the outputs of many service industries make it impossible to be certain about widespread productivity improvements among the service industries. Nevertheless, goods producing industries in the U.S. that are IT intensive have achieved higher productivity growth than those that have not invested heavily in IT.³²

Figure 19 Average annual growth in gross product originating (output) per worker, 1990-97 (%)



Notes: Selected services industries exclude 10 hard to measure services industries.

Source: Economics and Statistics Administration (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, pp40-41.

Focusing on some of the most intensive ICT using service industries in the U.S., Triplett and Bosworth found that from 1987 to 1997, multifactor productivity grew 9 per cent a year among security and commodity brokers, 2.1 per cent a year among insurance carriers, and 2.2 per cent a year among holding and investment offices. They also found that productivity gains in these industries in the decade to 1997 significantly exceeded gains in the period 1960 to 1973.³³

Table 7 Selected firm-level studies on ICT, productivity and organisational change

<i>Study</i>	<i>Sample</i>	<i>Issue</i>	<i>Main findings</i>
Lichtenberg (1995)	U.S. firms, 1988-91	Output contribution of capital and labour deployed in information systems	One information systems employee can substitute for 6 non-information systems employees without affecting output
Brynjolfsson and Hitt (1997)	More than 600 large U.S. firms, 1987-94	Impact of the adoption of IT and decentralisation on productivity	Firms that both adopt IT and decentralisation are on average 5% more productive than firms that adopt only one
Black and Lynch (1997 & 2000)	U.S. firms, 1987-93 & 1993-96	Impact of workplace practices, IT and human capital on productivity	The adoption of newer work practices, higher education levels and the use of computers by production workers have a positive impact on plant productivity
Brynjolfsson & Yang (1998)	Fortune 1000 U.S. firms, 1987-94	Impact of IT and intangible assets on firm performance	The market value of \$US 1 of IT capital is the same as that of \$US 10 of capital stock – reflecting the value of intangible investment associated with ICT
Brynjolfsson, Hitt & Yang (1998)		Impact of the adoption of IT and decentralisation on productivity	The market value of \$US 1 of IT capital is higher by \$US 2-5 in decentralised firms
Bresnahan, Brynjolfsson & Hitt (1999)	400 large firms, 1987-96	Complementarity between IT investment, human capital and decentralisation	IT combined with work practices such as higher skills, greater educational attainment, greater use of delegated decision making, lead to a higher value of IT investment

Source: OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p56.

Recent firm-level evidence shows that IT contributes substantially to productivity growth – especially where IT investments are complemented by organisational change and other intangible investments.³⁴ Many studies have found that ICT has a positive impact on firm performance when its introduction is associated with complementary organisational change.³⁵ For example, Brynjolfsson and Hitt grouped firms on the

basis of levels of IT investment and degree of decentralisation, and found that not only was average productivity highest among firms with higher IT investment and decentralisation, but also that productivity was lowest among those firms high in IT investment but low in decentralisation.³⁶

While many studies have found that ICTs have a positive impact of firm performance, it may well be that impacts are more significant when one focuses on the entire value chain. AutoXchange, developed by the big three U.S. car makers, but open to manufactures in other sectors and countries, is projected to realise cost savings of about 20 per cent. U.S. durable goods manufactures are reported to have reduced inventories as a share of sales by more than 25 per cent between 1989 and 1999, and this does not take into account savings associated with not having to finance or warehouse those inventories.³⁷

Whether one looks at the ICT-producing industries or intensive ICT using industries there seems to be clear evidence of the positive contribution of ICTs to output growth, productivity and competitiveness. The U.S. Department of Commerce has concluded that: "based on both macroeconomic and firm-level analysis, IT makes a substantial contribution to overall productivity growth."³⁸

The Australian case: the impact of ICTs in Australia

As noted above, the ICT-producing industries in Australia account for a smaller share of the national economy than they do in other developed countries. As we have also noted, the principal contribution of ICTs in the U.S. economy comes from the ICT-producing industries – with user industry spillover effects as yet somewhat smaller. Consequently, it is likely that Australia has yet to benefit from ICTs to the extent that some other countries have. In this section we attempt to explore this hypothesis.

Aggregate impact of ICTs on the Australian economy

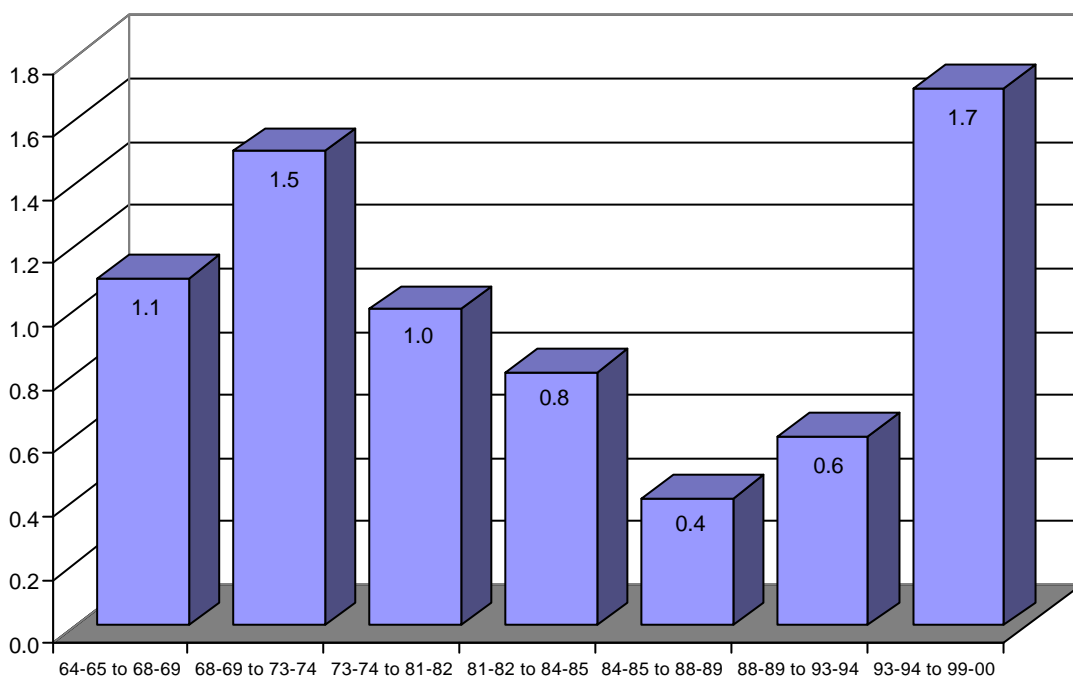
There has been no thorough study of the impact of ICTs on output and productivity in Australia. Nevertheless, there is some evidence to suggest that the impact might be substantial.

In a study of the potential aggregate and sectoral impacts of e-commerce in Australia, NOIE suggested that increased use of e-commerce could:

- boost national output by 2.7 per cent over the next decade – worth of the order of \$14 billion per annum;
- increase real investment by 4 per cent, and consumption by 3 per cent;
- increase aggregate employment by 0.5 per cent and real wages by 3.5 per cent; and
- contribute 2 per cent to an appreciation of the real exchange rate.³⁹

Recent Australian data show that there was a substantial acceleration of multifactor productivity growth during the most recent business cycle (1993-94 to 1999-00) – with productivity growth averaging 1.7 per cent a year, compared to average rates in the range 0.4 to 1.5 in previous cycles. Exploring the sectoral origins of this recent productivity growth, the Productivity Commission have shown that the relatively high intensity ICT using industries identified by U.S. studies are significant contributors – eg. wholesale trade (supply chain), finance and insurance services, manufacturing and communication services.⁴⁰

Figure 20 Multifactor productivity growth in Australia, 1964-65 to 1999-00 (compound annual % change between growth cycle peaks)



Source: ABS (2000) *Australian System of National Accounts 1999-2000*, 5204.0, Canberra, p28.

One notable aspect of the Productivity Commission's analysis of Australian data is that labour productivity rose during the 1990s due to high multifactor productivity growth. This could be indirectly related to ICT investments *if* those investments induced the kind of productivity enhancing organisational changes so widely noted in firm level studies. Goldman Sachs analysis suggested that Australian productivity could rise by 0.32 per cent a year over the next 10 years as a result of e-commerce, with increased investment in ICT lifting Australian labour productivity by 0.55 per cent to 0.8 per cent a year.⁴¹

Productivity impact of ICTs in Australia

Gruen recently adopted the Oliner and Sichel growth accounting method to measure the contribution of ICT investment to Australia's productivity growth. His results indicated that ICTs made a significant contribution to labour productivity growth in Australia during the 1990s, that ICTs contributed more to productivity growth than generic capital deepening, and that the direct contribution of ICTs increased during the 1990s.⁴²

By disaggregating Australian national accounts data it is now possible to calculate the contribution of capital investment in ICTs to growth in labour productivity during the 1990s.⁴³ The table below outlines the contribution of capital deepening in ICT capital to labour productivity growth during the periods 1991-92 to 1995-96 and 1995-96 to 1999-00. It shows that ICTs are indeed contributing to productivity improvements across the economy.

Table 8 Impact of ICTs on labour productivity in Australia (percentage)

	<i>Computers</i>	<i>Comms & Electronics</i>	<i>Software</i>	<i>Total ICT</i>	<i>Total Capital</i>
1991-92 to 1995-96					
Agriculture	0.16	-0.39	0.10	-0.13	-3.17
Mining	0.03	0.02	0.08	0.13	14.83
Manufacturing	0.77	0.04	0.71	1.52	8.63
Electricity, Gas & Water	0.33	1.29	0.17	1.78	29.93
Construction	0.69	-0.74	0.55	0.50	-11.22
Wholesale	0.65	-0.54	1.28	1.39	-2.00
Retail	1.62	0.34	0.80	2.76	7.17
Hospitality	0.37	0.46	0.30	1.12	0.88
Transport & Storage	0.12	0.02	0.20	0.34	-3.99
Communication	0.20	5.52	0.55	6.26	3.44
Finance & Insurance	1.19	-0.11	1.64	2.73	3.96
Cultural & Recreational	0.71	0.33	0.67	1.71	12.03
<i>Average</i>	<i>0.57</i>	<i>0.52</i>	<i>0.59</i>	<i>1.68</i>	<i>5.04</i>
<i>Share %</i>	<i>11.32</i>	<i>10.29</i>	<i>11.66</i>	<i>33.27</i>	<i>100.00</i>
1995-96 to 1999-00					
Agriculture	0.39	-0.11	0.25	0.52	-2.66
Mining	0.18	0.22	0.14	0.54	40.47
Manufacturing	2.07	0.29	1.19	3.55	15.19
Electricity, Gas & Water	2.92	3.97	0.16	7.05	21.13
Construction	1.28	-0.90	1.12	1.50	-12.56
Wholesale	2.47	-0.10	2.51	4.87	3.50
Retail	3.28	0.81	1.49	5.58	13.63
Hospitality	1.24	0.72	0.56	2.52	-1.95
Transport & Storage	0.35	-0.09	0.31	0.57	1.06
Communication	4.17	15.40	0.55	20.12	30.14
Finance & Insurance	3.14	-0.35	8.41	11.21	6.48
Cultural & Recreational	4.74	7.09	0.85	12.68	32.36
<i>Average</i>	<i>2.19</i>	<i>2.24</i>	<i>1.46</i>	<i>5.89</i>	<i>12.23</i>
<i>Share %</i>	<i>17.88</i>	<i>18.35</i>	<i>11.95</i>	<i>48.18</i>	<i>100.00</i>

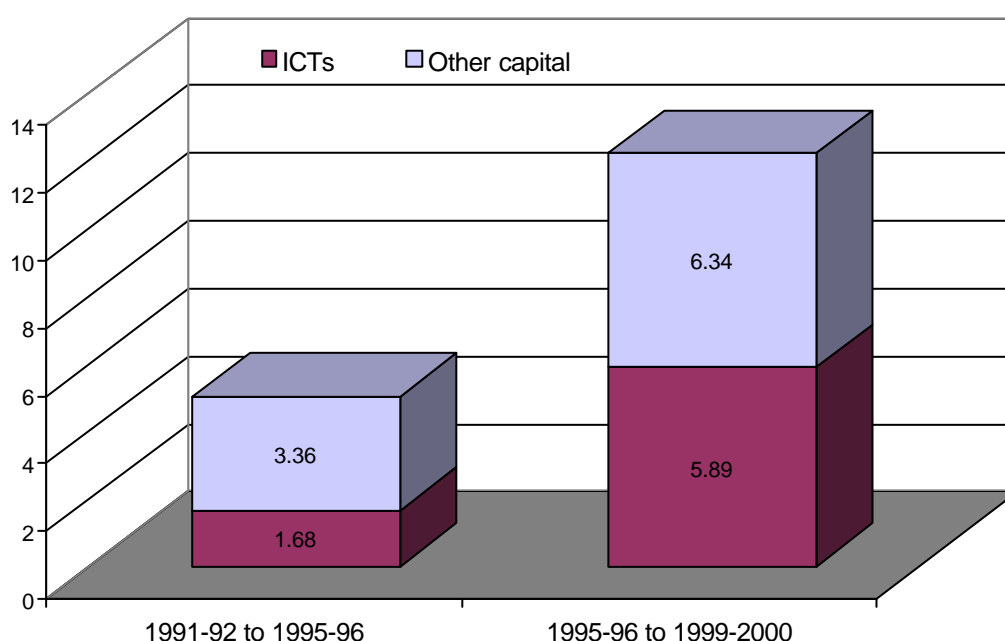
Source: Compiled from various ABS sources.

Growth in the ratio of each type of capital to labour hours generated labour productivity growth during both periods, but it was particularly noticeable during the later period. ICTs made a greater contribution to labour productivity growth during the late 1990s than during the early 1990s.

For example:

- increased computer capital intensity contributed 4.74 percentage points of labour productivity growth in the cultural and recreational service industries during the period 1995-96 to 1999-00, 4.17 percentage points of labour productivity growth in the communications industry, and 3.28 percentage points of labour productivity growth in the retail industry;
- capital deepening in computer software contributed 8.41 percentage points of labour productivity growth during 1995-96 to 1999-2000 in the finance and insurance industry, and 2.51 percentage points of labour productivity growth in the wholesale industry; and
- capital deepening in electronic equipment (including communications equipment) contributed 15.4 percentage points of labour productivity growth in the communications industry during the period 1995-96 to 1999-00, 7.1 percentage points of labour productivity growth in the cultural and recreational services industry, and almost 4 percentage points of labour productivity growth in the electricity, gas and water industries.

Figure 21 Contribution of ICTs to labour productivity growth due to capital deepening (%)



Source: Compiled from various ABS sources. Own analysis.

During the early 1990s, ICT capital deepening contributed an average 1.68 percentage points to labour productivity growth across those industries for which data are available. During the second half of the 1990s, ICTs contributed an average 5.89 percentage points. Similarly, ICTs contributed 33 per cent to the percentage point growth in labour productivity due to capital deepening during the early 1990s, rising to 48 per cent during the second half of the decade.

In the United States, ICTs contributed 38 per cent to labour productivity growth between 1996 and 1999 – computer hardware alone contributed almost 24 per cent, and computer software contributed a further 10.5 per cent. In Australia, between 1995-96 and 1999-00, computer hardware contributed 18 per cent and software 12 per cent of the average percentage point growth in labour productivity due to capital deepening in the 12 industries for which data are available.

Sectoral and industry level impacts

E-commerce Beyond 2000 provides estimates of the potential sectoral and regional impacts of e-commerce in Australia over the decade to 2007. Looking at the estimated potential impact of ICTs on output the study forecast a: 4.3 per cent increase in activity in the entertainment and hospitality industries by 2007; 3.4 per cent growth in the communications sector; 2.7 per cent growth in the banking and finance industries, and the health sector; 2.2 per cent growth in education and transport; 1.6 per cent growth in manufacturing; and 1.4 per cent growth in the food products sector. The IT and other equipment industries, transport equipment, business services, wholesale and retail industries were also forecast to grow by between 0.5 and 0.8 per cent by 2007.⁴⁴

While the potential impact of e-commerce on different industries varies, much of the forecast impact came from cost savings in the supply chain. In banking, for example, the U.S. Department of Commerce suggested that internet banking could see costs fall from over \$US 1 per transaction in branch banking to near zero. Communications equipment manufacturer, Cisco, estimated that putting their applications online was saving the company \$US 363 million a year by 1998, or approximately 17.5 per cent of total operating costs.⁴⁵ And in Australia's pharmaceutical industries, wholesalers expect to reduce the cost of processing orders from \$75 by paper to as low as \$5 using e-commerce.⁴⁶

Summary

Direct evidence of the impacts of ICTs on productivity remains shrouded in methodological difficulties, but analysts are beginning to unravel the mystery. There is evidence that ICTs have been making a very substantial contribution to the U.S. economy during the 1990s. Other countries also appear to be reaping benefits. The ICT-producing industries make a smaller direct contribution in Australia than in most developed countries, but evidence of the benefits of ICT investment and usage is now emerging.

Appendix A Defining ICTs

The ICT industries

Historically, there have been a number of approaches based on various definitions of IT. Major among these have been 'information processing capability', the use of 'integrated circuits', and the 'Net'. Over the years, technologies have developed to the point where almost everything has ICs embedded and/or has information processing capabilities – eg. car ignition and ABS systems, washing machines, etc. Consequently, analysts have moved towards using the Net as the defining principle, such that ICTs are anything that contributes to the communication and processing of information in (largely) digital form, using (largely) electronic networks.⁴⁷

The ICT industries

Industry	Including:
ICT Equipment	
Computer & business machine mfg	Office machines, computers, peripherals & terminals
Telecom & Broadcast equipment mfg	Telecoms, TV & radio equipment, modems, etc.
Electronic equipment mfg	Semiconductors, PCBs, etc.
Cable & Wire mfg	Co-axial, optical fibre, etc.
Computer wls	Computer wholesaling
Business machine wls	Business machine wholesaling
Electrical & Electronic equipment wls	ICT related equipment wholesaling
Communications Services	
Telecommunications services	Telephone, cable, TV & radio relay, & ISPs
Computer/Information services	
Computer consultancy	Consultancy, programming & analysis, etc.
Computer maintenance	ICT engineering, maintenance & repair services.
Data storage & retrieval	Database services, etc. (excluding library)
Data processing	Data processing, entry, bureau services, etc.
Software & Content	
Recorded media mfg & publishing	Packaged software, games & multimedia

Mfg = manufacturing

Wls = wholesaling

Hence, the ICT industries are those industries that produce all the elements of modern information and communication networks, including: the production of information and communication equipment and parts, all the related services and content.

ICT Jobs

Occupations considered to be directly ICT jobs are outlined in the table below.

ICT Occupation
<i>IT Management</i>
Information Technology Manager
<i>ICT Sales</i>
Sales representatives (Information & Communication Products)
Computing professionals & technicians
Systems manager
Systems designer
Software designer
Applications and analyst programmer
Systems Programmer
Computer systems auditor
Computing professionals, n.e.c.
Computing support technician
<i>Electrical and electronics engineers & technicians</i>
Electronics engineer
Electrical or electronics engineering technologists
Electronic engineering associate
Electronic engineering technician
Supervisor, electronic and office equipment tradesperson
Business machine mechanic
Apprentice electronic equipment tradesperson
Apprentice business machine mechanic
Electrical or telecommunications trades assistant
<i>Communications Tradespersons</i>
Supervisor, communications tradesperson
General communications tradesperson
Communications linesperson
Apprentice general communications tradesperson
Apprentice Communications linesperson

Notes

- ¹ Detailed definitions of the ICT-producing industries and ICT occupations can be found in Appendix A.
- ² Henry, D. & Dalton, D. (2000) 'Information Technology Industries', *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, p23.
- ³ In current prices.
- ⁴ Cooke, S.D. (2000) 'The Information Technology Workforce,' *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, p43.
- ⁵ Excluding proprietors.
- ⁶ Subtracting ICT professionals employed in the ICT-producing industries to avoid any double counting.
- ⁷ DISR (2001) *Structural Change in Australian Industry*, DISR, Canberra; and DISR (2001) *Industry Outlook 2001*, DISR, Canberra.
- ⁸ Bryan, M. (2001) 'Call on Call Centres', *Australian Financial Review*, 2 March 2001, p54.
- ⁹ Kitney, D. (2001) 'Leighton Diversification a Boon,' *Australian Financial Review*, 21 February 2001, p17.
- ¹⁰ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, pvi.
- ¹¹ World Information Technology and Services Alliance (2000) *Digital Planet 2000: The Global Information Economy*, WITSA. There are various ways to look at expenditure on ICTs in Australia. One can examine: ICT market data in order to get a sense of both the level and structural composition of expenditures; comparative international market and internal ICT expenditures; ICT expenditures by government, households and some (but not all) industries; and capital expenditure on ICT equipment and software throughout the Australian economy. In this chapter we explore these various data sources, and try to piece together a picture of ICT expenditure in Australia.
- ¹² Houghton, J.W. (2001) *Information Industries Update 2001*, Centre for Strategic Economic Studies, Melbourne. www.cfses.com
- ¹³ Both included a somewhat wider range of content that is included in the definition adopted in this report.
- ¹⁴ World Information Technology and Services Alliance (2000) *Digital Planet 2000: The Global Information Economy*, WITSA.
- ¹⁵ World Information Technology and Services Alliance (2000) *Digital Planet 2000: The Global Information Economy*, WITSA.
- ¹⁶ Gurmukh, G., Dumagan, J. & LaPorte, S. (2000) 'Contribution of Information Technology to U.S. Productivity Growth,' *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, p33.
- ¹⁷ This summary is derived from Schreyer, P. (2000) *The Contribution of Information and Communication Technology to Output Growth: A Study of the G7 Countries*, STI Working Paper 2000/2, OECD, Paris.
- ¹⁸ The OECD uses a somewhat more restricted definition of the ICT industries for purposes of international comparative analysis.
- ¹⁹ OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p50; reporting on Schreyer, P. (2000) *The Contribution of Information and Communication Technology to Output Growth: A Study of the G7 Countries*, STI Working Paper 2000/2, OECD, Paris.
- ²⁰ Multifactor productivity growth reflects the impact of factors in addition to performance adjusted capital and labour inputs, such as technical changes not directly incorporated in capital and labour (eg. new production processes), organisational improvements and economies of scale.

- ²¹ Jorgenson, D.W. & Stiroh, K.J. (2000) 'Raising the Speed Limit: U.S. Economic Growth in the Information Age', Harvard University and Federal Reserve Bank of New York; cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p51.
- ²² OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²³ Shinozaki, A. (1999) 'An empirical analysis of information-related investment in Japan and its impact on the Japanese economy,' Kyushu University, Japan; cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²⁴ Gera, S. et al (1999) 'Information Technology and Labour Productivity Growth,' Canadian Journal of Economics, 32(2), pp384-407; cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²⁵ SESSI (1999); cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²⁶ OECD (2000) Mobilising Human Resources for Innovation, DSTI/STP/TIP (99)2/Final, OECD, Paris; cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²⁷ Yoo, K. (2000) 'The Role of IT Industry in Korean Economy,' Ministry of Finance and Economy, Seoul; cited in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris.
- ²⁸ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000.
- ²⁹ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p39.
- ³⁰ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p35.
- ³¹ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p35.
- ³² U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p39.
- ³³ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p40.
- ³⁴ U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p41.
- ³⁵ OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p55.
- ³⁶ Brynjolfsson, E. & Hitt, L.M. (1998) 'Beyond the Productivity Paradox: Computers are the Catalyst for Bigger Changes,' *Communications of the ACM*, August 1998; reported in U.S. Department of Commerce (2000) *Digital Economy 2000*, U.S. Department of Commerce, Washington DC, June 2000, p41.
- ³⁷ U.S. Department of Commerce, reported in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p56.
- ³⁸ U.S. Department of Commerce, reported in OECD (2000) *A New Economy? The changing role of innovation and information technology in growth*, OECD, Paris, p42.
- ³⁹ NOIE (2000) *E-commerce beyond 2000 (Final report)*, DCITA, Canberra.
- ⁴⁰ Productivity Commission (1999) *The New Economy? A New Look at Australia's Productivity Performance*, Staff Research paper, May 1999, p13.

- ⁴¹ Cited in Shann, E. (2000) 'All Aboard for a Second Wave of Productivity Growth,' *The Economist*, 15 September, 2000. See also NOIE (2000) *The Current State of Play*, November 2000, www.noie.gov.au
- ⁴² Gruen, D. (2001) *Australia's Productivity Performance: Can it be Sustained?*, Reserve Bank of Australia, cited in Evans, B. (2001) 'The New Economy and Productivity in Australia: Impact on Currencies and Investment Flows', Euromoney International Bond Congress, February 2001, Westpac Institutional Bank.
- ⁴³ The contribution of capital deepening to labour productivity growth for each type of capital equals the rate of growth of the ratio of the capital type to labour hours multiplied by the income share of the same type of capital. ABS provided chain volume estimates of the net capital stock of computers and peripherals, electronic and electrical equipment (including communications equipment), and computer software by industry. To calculate the ratio of each of these to labour hours, indexes of labour hours by industry were obtained from ABS catalogue 5204.0. To calculate the share of each type of capital in total net capital stock, estimates of total net capital stock by industry were also obtained from ABS catalogue 5204.0.
- ⁴⁴ NOIE (2000) *E-commerce beyond 2000 (Final report)*, DCITA, Canberra, pp25-28.
- ⁴⁵ U.S. Department of Commerce (1998) *The Emerging Digital Economy*, Washington DC.
- ⁴⁶ NOIE (2000) *E-commerce beyond 2000 (Final report)*, DCITA, Canberra.
- ⁴⁷ A detailed description of issues in defining ICT industries and markets can be found in Houghton, J.W., Pucar, M. and Knox, C. (1996) *Mapping the Information Industries*, Productivity Commission, Canberra, July 1996; Houghton, J.W. (1999) 'Mapping Information Industries and Markets,' *Telecommunication Policy*, 23(10/11), November & December 1999, pp689-700; and Houghton, J.W. (2001) *Information Industries Update 2001*, Centre for Strategic Economic Studies, Melbourne (see www.cfses.com).