2000–01 8104.0

Australian Bureau of Statistics

RESEARCH AND EXPERIMENTAL DEVELOPMENT

BUSINESSES AUSTRALIA

EMBARGO: 11.30AM (CANBERRA TIME) MON 1 JUL 2002

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■ For further information about these and related statistics, contact the National Information and Referral Service on 1300 135 070 or Kevin Squair on Canberra 02 6252 5707.

NOTES

RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) GUIDELINES

Australian Bureau of Statistics (ABS) surveys of R&D are conducted in accordance with standard guidelines promulgated by the Organisation for Economic Co-operation and Development (OECD).

The surveys are based on a complete enumeration of businesses identified by the ABS as likely R&D performers. Businesses mainly engaged in Agriculture, forestry and fishing (i.e. industries in Division A of the Australian and New Zealand Standard Industrial Classification (ANZSIC)) are excluded partly because of collection difficulties and partly because such businesses are believed to have very low R&D activity (agricultural R&D activity is generally carried out by specialised research institutes not included in Division A).

REVISIONS

It should be noted that data presented in this publication may be subsequently revised. Where businesses newly identified as R&D performers indicate that R&D has been undertaken in earlier years, details are collected and used to revise previously released estimates. These revisions are generally small and do not impact significantly on the year to year movement statistics. Where revisions have been applied, the estimate is annotated with an 'r'.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
GDP	gross domestic product
n.e.c.	not elsewhere classified
OECD	Organisation for Economic Co-operation and Development
R&D	research and experimental development
BERD	Business expenditure on R&D
RFCD	Research fields, courses and disciplines
SEO	Socio-economic objective

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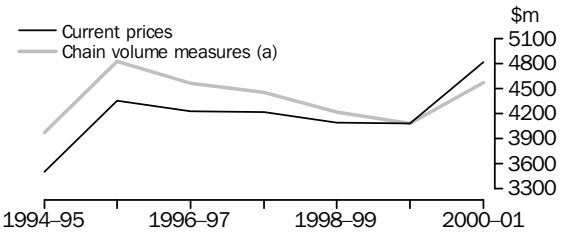
MAIN FEATURES

EXPENDITURE ON R&D

In 2000–01, Business Expenditure on R&D (BERD) was estimated to be $4,825m at current prices, 18% higher than that recorded in 1999–2000. This is the highest level recorded and reverses the declines of the previous four years.

In volume terms, with the effect of changes in prices and wages and salaries removed, R&D expenditure increased by 12% compared with 1999–2000. The 2000–01 expenditure in volume terms is 5% below the peak level of 1995–96.

EXPENDITURE ON R&D



(a) Reference year for chain volume measures is 1999–2000.
See paragraph 19 of the Explanatory Notes for details.

The Mining industry recorded a 57% increase in R&D expenditure, reversing the falls of the preceding three years. Expenditure by the Manufacturing industry increased by 8%. The Finance and insurance industry recorded an increase in R&D expenditure of 91%, while the Property and business services industry recorded an increase of 12%.

The change in BERD between 1999–2000 and 2000–01 resulted from:

- Approximately 2,600 businesses which undertook expenditure in both years, incurring $3,728m of R&D in 1999–2000 and $4,385m in 2000–01, an increase of 18%. Not all businesses increased their expenditure in 2000–01; 45% of continuing R&D performers recorded increases in expenditure of 10% or more, while 32% recorded decreases of 10% or more.
- Approximately 800 businesses which recorded $356m of R&D in 1999–2000, not reporting any R&D in 2000–01.
- Approximately 900 businesses which did not report R&D in 1999–2000, recording $440m in 2000–01.

HUMAN RESOURCES DEVOTED TO R&D

Human resources devoted to R&D in 2000–01 totaled 27,839 person years, 5% higher than in 1999–2000.

RESOURCES DEVOTED TO R&D

	1994–95	*1995–96*	*1996–97*	*1997–98*	*1998–99*	*1999–2000*	*2000–01*
Expenditure							
At current prices *($m)*	3 508.3	4 356.6	r4 234.7	r4 218.2	r4 091.2	r4 084.8	4 825.3
Chain volume measures(a) *($m)*	3 979.4	4 830.2	4 565.5	4 456.9	4 226.0	4 084.8	4 572.1
Human resources *(person years)*	25 812	27 123	r26 412	r24 772	r25 104	r26 411	27 839

r revised

(a) Reference year for chain volume measures is 1999-2000. See paragraph 19 of the Explanatory Notes.

BERD AS A PERCENTAGE OF GDP

Australia's BERD as a percentage of GDP increased to 0.72% in 2000–01, following decreases in the previous four years. The percentage remains well below the high of 0.87% in 1995–96.

BERD AS A PERCENTAGE OF GDP

Australia's BERD/GDP ratio remains relatively low when compared with other OECD countries as shown in the table below.

BERD/GDP RATIOS OF OECD COUNTRIES

	1998–99	*1999–2000*	*2000–01*
	%	%	%
Finland	1.94	2.19	2.35
Japan	2.09	2.07	na
United States of America	1.94	1.98	2.08
Korea	1.79	1.76	na
Germany	1.57	1.70	1.73
Belgium	1.35	1.42	1.47
France	1.35	1.38	1.37
United Kingdom	1.20	1.27	na
Canada	1.08	1.04	1.10
Czech Republic	0.80	0.79	0.81
Australia	**0.69**	**0.65**	**0.72**
Italy	0.52	0.54	0.55
Spain	0.47	0.46	0.48
Hungary	0.26	0.28	0.36
Poland	0.30	0.31	0.25

na not available

RESOURCES DEVOTED TO R&D

INDUSTRY COMPARISON

- R&D expenditure by the Mining industry increased by 57% in 2000–01 to $456m (9% of total R&D expenditure).
- The Manufacturing industry's R&D expenditure increased by 8% to $2,170m in 2000–01 (45% of total R&D expenditure).
- The Finance and insurance industry recorded an increase in R&D expenditure of 91% in comparison with 1999–2000, while the Property and business services industry recorded an increase of 12%.
- The Mining industry's R&D human resources increased by 51% when compared to 1999–2000 whilst accounting for 4% of total R&D human resources.
- Human resources devoted to R&D by the Manufacturing industry increased by 2% on 1999–2000 and accounted for 51% of total R&D human resources.

TYPE OF EXPENDITURE

In 2000–01, Labour costs accounted for 44% of total R&D expenditure. Other current expenditure made up 47%, while Capital expenditure accounted for 9%.

Labour costs as a proportion of R&D expenditure was low for the Mining industry (22%) and high for the Property and business services industry (61%).

TYPE OF ACTIVITY

In 2000–01, Experimental development was the most significant type of R&D activity undertaken by businesses. Expenditure on Experimental development was $3,333m (69% of total R&D expenditure). Applied research accounted for $1,188m (25%), while Basic research only accounted for $304m (6%). The industry with the highest proportion of its R&D expenditure directed towards Experimental development was the Wood and paper products industry (92%). Applied research was highest in the Industrial machinery and equipment industry (40% of its R&D expenditure) and the Scientific research industry (38%). Basic research was low in all industries, with the Scientific research industry recording the highest percentage (14%).

SOURCE OF FUNDS FOR R&D

The business sector provided most of the R&D expenditure funds itself: $4,337m (90%) was sourced from Own funds and $78m (2%) from Other businesses. The Commonwealth Government provided $171m (4%) while $207m (4%) came from Overseas.

The Scientific research industry provided only 56% of its R&D expenditure funding from Own funds. For this industry, a further 21% was provided by the Commonwealth Government, 9% from Overseas and 9% from Other businesses.

STATE COMPARISONS

The leading States in terms of R&D expenditure were New South Wales with $1,699m and Victoria with $1,686m, each accounting for 35% of total R&D expenditure. Queensland recorded $512m (11%), while Western Australia with $473m (10%) had the next highest R&D expenditure.

Compared to 1999–2000, R&D expenditure increased by $276m (19%) in New South Wales, $193m (13%) in Victoria, $79m (18%) in Queensland, $47m (19%) in South Australia and $136m (41%) in Western Australia. Tasmania, the Northern Territory and the Australian Capital Territory, in total, decreased by $11m (10%).

In the Mining industry, Western Australia accounted for $210m (46%), Queensland $117m (26%) and New South Wales $53m (12%).

STATE COMPARISONS *continued*

Major contributors to R&D in the Manufacturing industry were Victoria $887m (41%) and New South Wales $727m (34%).

EXPENDITURE BY SIZE OF BUSINESS

The largest businesses, employing 1000 or more, accounted for 39% of total R&D expenditure (34% in 1999–2000). On average, this was more than $14m per business undertaking R&D.

The ABS defines small businesses as those employing less than 20 people. Small businesses accounted for 11% of R&D expenditure in 2000–01; 7% of Manufacturing and 14% of all other industries.

Businesses employing less than 10 people accounted for 6% of the R&D (5% in 1999–2000). This averaged out at approximately $242,000 for each business undertaking R&D.

SOCIO-ECONOMIC OBJECTIVE

Most business R&D ($4,318m or 89%) was directed towards Economic development. Of this $1,947m (45%) was directed towards Manufacturing. Approximately 6% was directed towards Society, 2% towards Defence and 2% towards Environment.

RESEARCH FIELDS

Major fields in which business R&D expenditure took place were:

- computer software, $729m or 15%;
- communications technologies, $548m or 11%;
- manufacturing engineering, $390m or 8%;
- automotive engineering, $349m or 7%; and
- medical and health sciences, $299m or 6%.

EXPECTED R&D EXPENDITURE

Table 9 provides data on both 'actual' and 'expected' R&D expenditure by businesses.

The 'actual' data are the R&D business expenditures reported in the 1998–99, 1999–2000 and 2000–01 surveys.

In each of these surveys, businesses were also asked to report the level of expenditure they expected to incur in the following 12 months. These estimates are respectively shown as 1999–2000, 2000–01 and 2001–02 'expected' data in the table. These 'expected' estimates should be used with caution because, for many businesses, any forecast expenditure is simply a best guess.

Businesses reported that they expected BERD to be $4,850m in 2001–02. This is 1% higher than the actual R&D expenditure incurred in 2000–01. It should be noted that for 1999–2000 and 2000–01, actual expenditure exceeded expectations by 8% and 12% respectively.

HUMAN RESOURCES BY SIZE OF BUSINESS

R&D performing businesses employing 1,000 or more contributed 28% of human resource effort. However only 1% of their total employment was devoted to R&D.

The ABS defines small businesses as those employing less than 20 people. Small businesses contributed 15% of human resources to R&D in 2000–01; 10% of Manufacturing and 21% of all other industries.

Businesses with less than 10 employees devoted 46% of their total employment to R&D, although they contributed only 8% of the total resources undertaking R&D.

TYPE OF HUMAN RESOURCES

Researchers comprised 57% of the human resources devoted to R&D, followed by Technicians with 29% and Other supporting staff with 14%. In Mining, Researchers accounted for 27% and Technicians 20%. Researchers made up 57% in Manufacturing with 28% of R&D human resources accounted for by Technicians. The Property and business services industry and the Scientific research industry had high proportions of Researchers with 63% and 62% respectively.

Within the Manufacturing industries, the proportion contributed by Researchers ranged from a high of 69% in Printing, publishing and recorded media to a low of 36% in Wood and paper products.

EXTRAMURAL R&D EXPENDITURE

Extramural R&D expenditure (payments to other organisations to undertake R&D projects) by businesses was $408m in 2000–01, of which $343m was paid to organisations located in Australia and $65m to organisations located overseas.

1 RESOURCES DEVOTED TO R&D, By industry

	NUMBER OF BUSINESSES			EXPENDITURE ON R&D			HUMAN RESOURCES DEVOTED TO R&D		
	1998–99	*1999–00*	*2000–01*	*1998–99*	*1999–00*	*2000–01*	*1998–99*	*1999–00*	*2000–01*
ANZSIC	no.	no.	no.	$m	$m	$m	person years	person years	person years
Mining (including services to mining)	r*103*	r*100*	*89*	r*485*	r*291*	*456*	r*981*	r*772*	*1 169*
Manufacturing									
Food, beverages and tobacco	r149	r135	141	r209	r184	205	r1 135	r1 124	1 157
Textiles, clothing, footwear and leather	r55	r51	51	r21	r18	27	r182	r195	245
Wood and paper products	r28	r36	33	r84	r102	100	r230	r359	338
Printing, publishing and recorded media	34	r28	32	20	15	13	164	r169	102
Petroleum, coal, chemical and associated product	r312	r331	348	r324	r377	385	r2 188	r2 234	2 519
Non-metallic mineral product	59	r49	51	53	r47	41	369	r338	279
Metal product	174	r182	171	296	227	199	1 223	r1 128	962
Motor vehicle and part and other transport equipment	r125	139	135	r379	r410	473	r2 766	r3 059	3 043
Photographic and scientific equipment	103	r174	162	107	r128	180	941	r1 108	1 424
Electronic and electrical equipment and appliance	337	r323	372	r399	342	385	r2 870	2 764	2 754
Industrial machinery and equipment	232	r245	239	r116	r131	140	r1 097	r1 236	1 123
Other manufacturing	77	r88	88	19	20	23	212	r239	268
Total manufacturing	r*1 685*	r*1 781*	*1 823*	r*2 027*	r*2 002*	*2 170*	r*13 377*	r*13 952*	*14 213*
Other industries									
Wholesale and retail trade	r305	r297	291	r365	r387	388	r2 388	r2 597	2 602
Finance and insurance	r34	r35	36	r83	r138	264	r682	r953	910
Property and business services	r795	r874	932	r620	r744	831	r5 447	r5 959	6 420
Scientific research	r154	148	152	r162	r211	218	r1 192	r1 266	1 311
Other n.e.c.	r183	r192	194	r348	r312	498	r1 038	r913	1 214
Total other industries	r*1 471*	r*1 546*	*1 605*	r*1 579*	r*1 792*	*2 199*	r*10 746*	r*11 688*	*12 457*
Total	r**3 259**	r**3 427**	**3 517**	r**4 091**	r**4 085**	**4 825**	r**25 104**	r**26 411**	**27 839**

r revised

EXPENDITURE, By industry—By type of expenditure

ANZSIC	*Total* $'000	*Capital expenditure* $'000	*Labour costs*(a) $'000	*Other current expenditure* $'000
Mining (including services to mining)	*456 306*	*36 247*	*101 860*	*318 199*
Manufacturing				
Food, beverages and tobacco	205 462	27 506	90 565	87 391
Textiles, clothing, footwear and leather	26 740	2 722	12 671	11 347
Wood and paper products	100 039	7 130	25 741	67 168
Printing, publishing and recorded media	12 651	1 017	6 844	4 790
Petroleum, coal, chemical and associated product	384 566	29 174	170 875	184 518
Non-metallic mineral product	40 868	3 960	15 438	21 470
Metal product	198 532	31 096	74 734	92 702
Motor vehicle and part and other transport equipment	473 167	32 008	198 929	242 230
Photographic and scientific equipment	179 560	11 689	98 827	69 044
Electronic and electrical equipment and appliance	385 121	22 497	194 963	167 662
Industrial machinery and equipment	139 863	20 566	72 675	46 622
Other manufacturing	23 487	3 459	12 853	7 175
Total manufacturing	*2 170 056*	*192 821*	*975 114*	*1 002 120*
Other industries				
Wholesale and retail trade	388 292	17 902	210 532	159 858
Finance and insurance	263 861	59 238	131 609	73 014
Property and business services	830 918	54 974	509 719	266 226
Scientific research	218 024	24 014	94 554	99 456
Other n.e.c.	497 847	49 714	106 348	341 785
Total other industries	*2 198 942*	*205 842*	*1 052 761*	*940 338*
Total	**4 825 304**	**434 910**	**2 129 736**	**2 260 658**

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

3 EXPENDITURE, By industry—By type of activity(a)

ANZSIC	Total $'000	Basic research $'000	Applied research $'000	Experimental development $'000
Mining (including services to mining)	*456 306*	*23 237*	*106 315*	*326 754*
Manufacturing				
Food, beverages and tobacco	205 462	10 664	43 686	151 112
Textiles, clothing, footwear and leather	26 740	1 458	4 742	20 540
Wood and paper products	100 039	np	np	91 751
Printing, publishing and recorded media	12 651	786	1 583	10 282
Petroleum, coal, chemical and associated product	384 566	22 347	122 297	239 922
Non-metallic mineral product	40 868	2 746	9 314	28 808
Metal product	198 532	5 096	62 157	131 279
Motor vehicle and part and other transport equipment	473 167	4 472	69 330	399 365
Photographic and scientific equipment	179 560	14 620	61 860	103 080
Electronic and electrical equipment and appliance	385 121	35 190	57 529	292 403
Industrial machinery and equipment	139 863	5 411	56 286	78 166
Other manufacturing	23 487	np	np	18 151
Total manufacturing	*2 170 056*	*106 014*	*499 184*	*1 564 858*
Other industries				
Wholesale and retail trade	388 292	14 210	65 529	308 553
Finance and insurance	263 861	np	np	202 617
Property and business services	830 918	43 481	265 463	521 974
Scientific research	218 024	31 497	83 547	102 980
Other n.e.c.	497 847	np	np	305 279
Total other industries	*2 198 942*	*174 793*	*582 746*	*1 441 403*
Total	**4 825 304**	**304 044**	**1 188 245**	**3 333 015**

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) See paragraph 7 of the Explanatory Notes.

4 EXPENDITURE, By industry—By source of funds

ANZSIC	Total	Own funds	Other businesses	Commonwealth government	State and local government	Other Australian(a)	Overseas
	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mining (including services to mining)	*456 306*	*447 941*	*1 127*	*5 664*	np	—	np
Manufacturing							
Food, beverages and tobacco	205 462	198 152	np	3 282	28	1 029	np
Textiles, clothing, footwear and leather	26 740	23 455	—	3 240	—	45	—
Wood and paper products	100 039	99 822	—	np	—	np	—
Printing, publishing and recorded media	12 651	11 479	np	951	—	np	—
Petroleum, coal, chemical and associated product	384 566	340 419	130	6 124	np	np	37 144
Non-metallic mineral product	40 868	40 439	np	np	np	—	—
Metal product	198 532	192 886	np	2 828	np	np	—
Motor vehicle and part and other transport equipment	473 167	451 886	np	6 418	—	—	np
Photographic and scientific equipment	179 560	164 294	300	10 411	85	np	np
Electronic and electrical equipment and appliance	385 121	367 654	2 084	10 147	404	np	np
Industrial machinery and equipment	139 863	126 374	6 274	6 187	88	940	—
Other manufacturing	23 487	20 450	np	2 525	—	np	255
Total manufacturing	*2 170 056*	*2 037 310*	*12 550*	*52 415*	*891*	*5 123*	*61 768*
Other industries							
Wholesale and retail trade	388 292	328 839	2 272	np	442	np	50 842
Finance and insurance	263 861	263 308	np	np	—	—	—
Property and business services	830 918	662 275	40 765	51 164	2 511	1 790	72 413
Scientific research	218 024	123 161	19 083	46 169	2 918	6 562	20 131
Other n.e.c.	497 847	474 616	np	9 256	np	np	np
Total other industries	*2 198 942*	*1 852 199*	*64 641*	*112 657*	np	*17 860*	np
Total	**4 825 304**	**4 337 450**	**78 317**	**170 736**	**8 398**	**22 983**	**207 419**

np not available for publication but included in totals where applicable, unless otherwise indicated

— nil or rounded to zero (including null cells)

(a) Includes Higher education and Private non-profit sectors.

5 EXPENDITURE, By industry—By location(a)

ANZSIC	Total	NSW	Vic.	Qld	SA	WA	Other states and territories	Overseas
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mining (including services to mining)	*456 306*	*53 407*	*29 961*	*116 628*	*25 195*	*210 212*	*16 715*	*4 188*
Manufacturing								
Food, beverages and tobacco	205 462	83 158	73 113	23 345	12 868	7 901	3 976	1 101
Textiles, clothing, footwear and leather	26 740	6 609	15 065	np	np	np	np	np
Wood and paper products	100 039	8 739	71 676	7 179	2 342	4 169	np	np
Printing, publishing and recorded media	12 651	4 697	4 292	np	270	1 604	np	—
Petroleum, coal, chemical and associated product	384 566	120 903	161 184	47 795	28 422	14 600	10 063	1 599
Non-metallic mineral product	40 868	22 121	7 170	6 163	146	3 900	np	np
Metal product	198 532	86 023	32 711	29 092	np	np	5 066	np
Motor vehicle and part and other transport equipment	473 167	74 853	332 407	11 242	34 381	10 966	np	np
Photographic and scientific equipment	179 560	81 595	51 379	10 120	20 480	9 065	np	np
Electronic and electrical equipment and appliance	385 121	159 588	108 748	30 279	25 047	52 028	7 398	2 034
Industrial machinery and equipment	139 863	73 688	21 571	19 972	8 153	14 396	1 813	270
Other manufacturing	23 487	5 194	7 628	3 941	4 186	2 252	251	35
Total manufacturing	*2 170 056*	*727 167*	*886 944*	*191 980*	*141 754*	*164 341*	*45 754*	*12 116*
Other industries								
Wholesale and retail trade	388 292	156 807	141 976	17 790	56 766	7 294	3 265	4 394
Finance and insurance	263 861	121 337	125 316	np	—	np	—	np
Property and business services	830 918	373 957	187 997	125 352	46 889	50 694	23 424	22 605
Scientific research	218 024	77 604	74 448	25 865	15 588	10 075	5 829	8 615
Other n.e.c.	497 847	188 387	239 217	np	8 543	np	3 212	np
Total other industries	*2 198 942*	*918 092*	*768 954*	*203 465*	*127 786*	*98 254*	*35 730*	*46 661*
Total	**4 825 304**	**1 698 666**	**1 685 859**	**512 073**	**294 735**	**472 807**	**98 199**	**62 965**

np not available for publication but included in totals where applicable, unless otherwise indicated

— nil or rounded to zero (including null cells)

(a) This may not be the location of the organisation's head office.

6 EXPENDITURE, By industry—By business employment size(a)

ANZSIC	Total	Less than 10	10–19	20–49	50–99	100–199	200–499	500–999	1000 or more
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mining (including services to mining)	*456 306*	*19 934*	np	*21 368*	*19 302*	*31 359*	*40 515*	np	*228 237*
Manufacturing									
Food, beverages and tobacco	205 462	3 239	570	8 107	20 545	7 107	25 180	22 086	118 628
Textiles, clothing, footwear and leather	26 740	641	np	2 716	4 663	4 406	8 232	4 882	np
Wood and paper products	100 039	1 665	np	450	np	557	1 364	3 463	90 345
Printing, publishing and recorded media	12 651	873	2 167	2 201	4 836	np	np	—	—
Petroleum, coal, chemical and associated product	384 566	8 509	8 745	25 737	30 249	45 328	75 133	93 428	97 437
Non-metallic mineral product	40 868	3 027	431	2 663	np	np	7 521	16 600	7 648
Metal product	198 532	4 912	2 639	42 044	25 469	8 863	20 673	14 184	79 748
Motor vehicle and part and other transport equipment	473 167	2 269	2 651	7 961	11 852	22 904	34 470	40 347	350 713
Photographic and scientific equipment	179 560	12 110	11 391	35 611	19 311	6 661	55 560	np	np
Electronic and electrical equipment and appliance	385 121	16 369	30 716	48 612	28 740	44 844	57 118	82 512	76 210
Industrial machinery and equipment	139 863	10 284	15 434	26 889	16 705	8 791	np	—	np
Other manufacturing	23 487	5 223	5 071	6 429	4 338	806	np	np	—
Total manufacturing	*2 170 056*	*69 121*	*80 621*	*209 420*	*168 486*	*154 838*	*315 284*	*308 525*	*863 761*
Other industries									
Wholesale and retail trade	388 292	17 472	12 674	33 623	25 924	34 813	91 148	51 123	121 515
Finance and insurance	263 861	8 035	np	3 426	—	np	32 738	27 327	184 729
Property and business services	830 918	102 998	93 751	140 172	108 908	np	75 052	np	104 374
Scientific research	218 024	50 153	np	59 719	43 296	np	—	—	—
Other n.e.c.	497 847	11 914	7 276	21 542	1 054	23 877	18 722	11 419	402 043
Total other industries	*2 198 942*	*190 572*	np	*258 482*	*179 182*	*236 979*	*217 660*	np	*812 661*
Total	**4 825 304**	**279 627**	**233 605**	**489 270**	**366 970**	**423 176**	**573 459**	**554 538**	**1 904 659**

np not available for publication but included in totals where applicable, unless otherwise indicated

— nil or rounded to zero (including null cells)

(a) Employment size is based on the number of persons employed by the business.

RESOURCES DEVOTED TO R&D, By socio-economic objective

	TYPE OF EXPENDITURE				
Socio-economic objective	*Total* $'000	*Capital expenditure* $'000	*Labour costs*(a) $'000	*Other current expenditure* $'000	*Human resources* person years
Defence	*117 936*	*865*	*71 885*	*45 186*	*712*
Economic development					
Plant–production and primary products	46 793	5 319	22 986	18 488	389
Animal–production and primary products	55 453	2 500	18 087	34 866	269
Mineral resources (excl. energy)	317 217	38 299	91 192	187 726	1 100
Energy resources	103 566	5 891	27 018	70 657	332
Energy supply	121 813	30 834	48 113	42 866	629
Manufacturing	1 946 957	169 882	818 742	958 334	12 113
Construction	59 933	5 407	23 164	31 362	348
Transport	80 569	6 713	41 341	32 516	644
Information and communication services	1 368 731	115 831	662 277	590 622	7 753
Commercial services and tourism	208 983	23 431	135 748	49 804	1 289
Economic framework	7 815	776	5 448	1 591	77
Total economic development	*4 317 832*	*404 884*	*1 894 117*	*2 018 832*	*24 942*
Society					
Health	276 063	19 061	117 726	139 276	1 461
Education and training	9 514	456	5 477	3 581	94
Social development and community services	24 872	3 272	12 739	8 861	198
Total society	*310 449*	*22 789*	*135 942*	*151 718*	*1 753*
Environment					
Environmental policy frameworks and other aspects	10 561	1 524	4 344	4 694	73
Environmental management	61 999	4 408	20 313	37 278	304
Total environment	*72 560*	*5 932*	*24 657*	*41 971*	*378*
Non-oriented research	*6 528*	*440*	*3 136*	*2 951*	*54*
Total	**4 825 304**	**434 910**	**2 129 736**	**2 260 658**	**27 839**

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

8 RESOURCES DEVOTED TO R&D, By research field

	TYPE OF EXPENDITURE				
Research field	*Total*	*Capital expenditure*	*Labour costs*(a)	*Other current expenditure*	*Human resources*
	$'000	$'000	$'000	$'000	person years
Mathematical sciences	30 660	1 341	17 854	11 465	245
Physical sciences	51 397	3 224	26 511	21 663	408
Chemical sciences	173 654	12 410	80 678	80 567	1 198
Earth sciences	50 376	3 295	11 522	35 559	189
Biological sciences	122 002	11 467	51 224	59 312	685
Information systems	221 497	19 338	108 341	93 819	1 266
Computer software	728 938	58 341	470 230	200 367	5 657
Other information, computing and communication sciences	308 856	32 928	126 709	149 219	1 467
Industrial biotechnology and food sciences	128 598	15 904	62 531	50 163	816
Chemical engineering	73 268	16 568	23 922	32 778	298
Manufacturing engineering	389 732	46 508	157 984	185 240	2 451
Automotive engineering	349 320	26 650	157 241	165 429	2 413
Mechanical and industrial engineering	163 390	31 800	69 235	62 355	1 028
Resources engineering	287 584	28 637	79 637	179 310	883
Electrical and electronic engineering	146 951	12 740	72 389	61 821	1 108
Metallurgy	158 020	8 681	32 203	117 137	374
Materials engineering	103 055	9 732	42 533	50 791	677
Communications technologies	548 315	38 659	189 371	320 285	2 160
Other engineering and technology	305 469	26 038	143 110	136 322	1 710
Agricultural, veterinary and environmental sciences	153 700	12 294	58 699	82 708	914
Medical and health sciences	299 485	15 541	126 659	157 286	1 632
Other research fields, courses and disciplines	31 035	2 818	21 155	7 063	263
Total	**4 825 304**	**434 910**	**2 129 736**	**2 260 658**	**27 839**

(a) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

9 EXPECTED AND ACTUAL EXPENDITURE ON R&D, By industry

	1998–99	1999–2000		2000–01		2001–02
	Actual	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*
ANZSIC	$'000	$'000	$'000	$'000	$'000	$'000
Mining (including services to mining)	r*484 742*	r*324 588*	r*290 871*	r*258 344*	*456 306*	*359 280*
Manufacturing						
Food, beverages and tobacco	r209 174	r179 593	r184 048	r184 895	205 462	210 490
Textiles, clothing, footwear and leather	r21 446	r19 716	r18 233	r20 943	26 740	27 737
Wood and paper products	r84 199	r73 648	r102 134	r91 157	100 039	86 840
Printing, publishing and recorded media	20 096	15 746	r15 316	r19 605	12 651	15 228
Petroleum, coal, chemical and associated product	r323 763	r335 452	r377 373	r347 786	384 566	406 514
Non-metallic mineral product	52 925	50 632	r46 804	r48 143	40 868	45 978
Metal product	295 593	204 890	r227 151	r196 323	198 532	199 874
Motor vehicle and part and other transport equipment	r378 893	r390 505	r409 968	r396 346	473 167	490 809
Photographic and scientific equipment	r106 926	r112 183	r128 432	r139 454	179 560	220 047
Electronic and electrical equipment and appliance	r399 121	r369 583	r341 798	r383 412	385 121	412 857
Industrial machinery and equipment	r115 857	r127 084	r130 700	r131 993	139 863	145 474
Other manufacturing	19 189	20 584	r20 238	r26 660	23 487	27 068
Total manufacturing	r*2 027 181*	r*1 899 617*	r*2 002 195*	r*1 986 715*	*2 170 056*	*2 288 914*
Other industries						
Wholesale and retail trade	r365 333	r374 516	r386 953	r407 802	388 292	393 735
Finance and insurance	r83 412	r57 339	r138 164	r294 725	263 861	254 297
Property and business services	r619 865	r621 605	r743 584	r750 427	830 918	850 350
Scientific research	r162 267	r183 069	r210 904	r229 479	218 024	277 882
Other n.e.c.	r348 409	r324 911	r312 108	r395 325	497 847	425 207
Total other industries	r*1 579 285*	r*1 561 440*	r*1 791 713*	r*2 077 758*	*2 198 942*	*2 201 472*
Total	r**4 091 208**	r**3 785 645**	r**4 084 779**	r**4 322 817**	**4 825 304**	**4 849 666**

r revised

10 HUMAN RESOURCES DEVOTED TO R&D, By industry—By business employment size(a)

ANZSIC	Total	Less than 10	10–19	20–49	50–99	100–199	200–499	500–999	1000 or more
	person years	person years	person years	person years	person years	person years	person years	person years	person years
Mining (including services to mining)	*1 169*	*34*	np	*62*	*58*	*122*	*59*	np	*655*
Manufacturing									
Food, beverages and tobacco	1 157	24	7	65	116	44	172	147	582
Textiles, clothing, footwear and leather	245	5	np	25	48	44	73	np	np
Wood and paper products	338	10	np	5	np	3	13	18	274
Printing, publishing and recorded media	102	5	13	22	35	np	np	—	—
Petroleum, coal, chemical and associated product	2 519	71	101	189	218	332	416	592	600
Non-metallic mineral product	279	20	np	21	np	24	36	127	46
Metal product	962	31	27	123	178	90	116	91	306
Motor vehicle and part and other transport equipment	3 043	25	25	75	72	166	370	302	2 010
Photographic and scientific equipment	1 424	123	97	227	153	59	462	np	np
Electronic and electrical equipment and appliance	2 754	215	291	415	241	255	471	340	527
Industrial machinery and equipment	1 123	87	134	268	140	np	175	—	np
Other manufacturing	268	59	43	71	61	11	np	np	—
Total manufacturing	*14 213*	*676*	*755*	*1 505*	*1 270*	*1 109*	*2 326*	*1 898*	*4 675*
Other industries									
Wholesale and retail trade	2 602	152	138	278	219	186	660	282	687
Finance and insurance	910	11	np	14	—	np	127	117	580
Property and business services	6 420	941	901	1 274	941	np	525	np	596
Scientific research	1 311	319	np	306	253	np	—	—	—
Other n.e.c.	1 214	75	50	124	12	162	99	49	644
Total other industries	*12 457*	*1 498*	np	*1 996*	*1 425*	*1 550*	*1 410*	np	*2 507*
Total	**27 839**	**2 207**	**2 087**	**3 563**	**2 752**	**2 781**	**3 796**	**2 816**	**7 837**

np not available for publication but included in totals where applicable, unless otherwise indicated

— nil or rounded to zero (including null cells)

(a) Employment size is based on the number of persons employed by the business, whereas human resources data are person years of R&D effort.

11 HUMAN RESOURCES DEVOTED TO R&D, By industry—By type of employee

ANZSIC	*Total* person years	*Researchers* person years	*Technicians* person years	*Other supporting staff* person years
Mining (including services to mining)	*1 169*	*320*	*234*	*615*
Manufacturing				
Food, beverages and tobacco	1 157	631	345	181
Textiles, clothing, footwear and leather	245	89	101	56
Wood and paper products	338	122	146	70
Printing, publishing and recorded media	102	70	26	6
Petroleum, coal, chemical and associated product	2 519	1 355	783	382
Non-metallic mineral product	279	102	114	63
Metal product	962	563	263	137
Motor vehicle and part and other transport equipment	3 043	1 574	924	545
Photographic and scientific equipment	1 424	941	329	153
Electronic and electrical equipment and appliance	2 754	1 833	638	283
Industrial machinery and equipment	1 123	645	280	198
Other manufacturing	268	132	81	56
Total manufacturing	*14 213*	*8 056*	*4 029*	*2 129*
Other industries				
Wholesale and retail trade	2 602	1 479	807	317
Finance and insurance	910	453	373	84
Property and business services	6 420	4 067	1 800	554
Scientific research	1 311	818	345	148
Other n.e.c.	1 214	639	411	164
Total other industries	*12 457*	*7 454*	*3 736*	*1 267*
Total	**27 839**	**15 830**	**7 998**	**4 011**

12 EXTRAMURAL R&D EXPENDITURE(a), By industry

		LOCATION OF RECIPIENT	
	Total	*Australia*	*Overseas*
ANZSIC	$'000	$'000	$'000
Mining (including services to mining)	*65 055*	*51 311*	*13 744*
Manufacturing			
Food, beverages and tobacco	11 989	np	np
Textiles, clothing, footwear and leather	2 007	1 574	433
Wood and paper products	15 155	np	np
Printing, publishing and recorded media	539	539	—
Petroleum, coal, chemical and associated product	47 057	41 444	5 613
Non-metallic mineral product	4 619	4 007	612
Metal product	9 536	9 086	450
Motor vehicle and part and other transport equipment	31 528	np	np
Photographic and scientific equipment	19 555	14 260	5 295
Electronic and electrical equipment and appliance	4 617	4 214	403
Industrial machinery and equipment	4 877	4 366	511
Other manufacturing	1 009	1 004	5
Total manufacturing	*152 488*	*122 591*	*29 897*
Other industries			
Wholesale and retail trade	24 516	np	np
Finance and insurance	17 952	17 952	—
Property and business services	47 731	39 672	8 059
Scientific research	48 707	40 501	8 206
Other n.e.c.	51 297	np	np
Total other industries	*190 203*	*169 341*	*20 862*
Total	**407 746**	**343 243**	**64 503**

np not available for publication but included in totals where applicable, unless otherwise indicated

— nil or rounded to zero (including null cells)

(a) Expenditure on R&D which is funded by a business but carried out by others.

EXPLANATORY NOTES

INTRODUCTION

1 This publication presents statistics on expenditure and human resources devoted to R&D carried out in Australia by the Business sector during 2000–01.

2 For details of R&D statistics available for the General government, Private non-profit and Higher education sectors see paragraph 22.

DATA SOURCES

3 The 2000–01 data presented in this publication have been compiled from data collected from businesses in the Survey of Research and Experimental Development in respect of the year ended June 2001. This survey was based on a complete enumeration of businesses identified by the Australian Bureau of Statistics (ABS) as likely R&D performers (businesses mainly engaged in Agriculture, forestry and fishing were excluded; see paragraph 13). The survey was conducted by mailed questionnaires and a 92% response was obtained. For businesses that did not respond to the current survey and had reported R&D activity in the previous survey, data were imputed based on the expected expenditures for 2000-01 reported previously. Where R&D activity had not been previously reported, the non-respondents were also deemed to be non-R&D performers for the current year.

4 The GDP figures used to derive BERD/GDP ratios are current at the time of manuscript finalisation (*Australian National Accounts: National Income, Expenditure and Product, March Quarter 2002* (Cat. no. 5206.0)) and, at current prices, are as follows: $471,348m (1994–95); $502,828m (1995–96); $529,886m (1996–97); $561,229m (1997–98); $591,592m (1998–99); $629,212m (1999–2000) and $672,223m (2000–01). The available BERD/GDP ratios for other OECD countries are current at the time of manuscript finalisation and are sourced from *Main Science and Technology Indicators, 2001-2*, OECD, Paris, 2001.

STATISTICAL UNIT

5 For businesses, the unit from which information is generally collected and published is the management unit. The management unit is the highest level accounting unit within a business, having regard for industry homogeneity, for which accounts are maintained; in nearly all cases it coincides with the legal entity owning the business (i.e. company, partnership, trust, sole operator, etc.). In the case of large diversified businesses, however, there may be more than one management unit, each coinciding with a 'division' or 'line of business'. A division or line of business is recognised where separate and comprehensive accounts are compiled for it.

DEFINITIONS

6 R&D is defined in accordance with the Organisation for Economic Co-operation and Development (OECD) standard as comprising 'creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications'.

7 Type of R&D activity comprises pure basic research, strategic basic research, applied research and experimental development. Data in this classification are subjectively allocated by respondents at the time of reporting, using OECD/ABS definitions. The ABS makes every effort to ensure correct and consistent interpretation and reporting of these data and applies consistent processing methodologies. Analysts using this classification should bear the original subjectivity in mind.

8 For a more comprehensive interpretation of the definition of R&D activity, contact the ABS or refer to the OECD publication *The Measurement of Scientific and Technical Activities ('Frascati Manual' 1993)*, OECD, Paris, 1994.

SCOPE

9 The scope of this survey is all businesses within the Business sector of Australia which have undertaken R&D.

10 The Business sector includes all businesses whose primary activity is the production of goods or services for sale to the general public at a price intended to cover at least the costs of production, and the private non-profit institutions mainly serving them.

11 The vast majority of businesses in this sector are private businesses. The remainder are public businesses mainly engaged in trading or financial activities.

COVERAGE

12 The 2000–01 R&D survey comprised a complete enumeration of businesses identified by the ABS as likely to have carried out R&D activity.

13 The Business sector for the R&D survey excludes businesses mainly engaged in Agriculture, forestry and fishing (i.e. industries in Division A of the *Australian and New Zealand Standard Industrial Classification (ANZSIC), 1993* (Cat. no. 1292.0)), partly because of collection difficulties and partly because such businesses are believed to have very low R&D activity (agricultural R&D activity is generally carried out by specialised research institutes not included in ANZSIC Division A).

14 Within the scope of the survey, businesses were included in the collection if they satisfied any of the following criteria:

- businesses which, in previous R&D surveys, reported R&D activity;
- businesses applying for the R&D Tax Concession and/or grants for Industry R&D;
- businesses identified from reports in newspapers, industrial journals, research compendia etc. as likely to have R&D activity; or
- businesses which indicated on an exploratory questionnaire that R&D activity had been undertaken.

15 The ABS continues to investigate enhancement of the above criteria, or the introduction of additional criteria, with the aim of further improving the coverage of the R&D survey.

INDUSTRY CLASSIFICATION

16 The statistics in this publication are classified to industry in accordance with the 1993 edition of the *Australian and New Zealand Standard Industrial Classification (ANZSIC)*.

17 Each management unit is classified by the ABS to the industry in which it mainly operates even though one or more of its component establishments (factories, shops, etc.) may be classified to other industries. In cases where an enterprise group sets up a dedicated research unit, that unit is classified to the predominant industry of the group rather than to ANZSIC 7810 Scientific research, in accordance with standards laid down in the Frascati Manual.

SOCIO-ECONOMIC OBJECTIVE AND RESEARCH FIELDS, COURSES AND DISCIPLINES CLASSIFICATIONS

18 Statistics of business R&D classified by Socio-economic objective (SEO) and Research fields, courses and disciplines (RFCD) have been collected and presented in this publication. Each business undertaking R&D was asked to categorise its R&D activity according to the purpose of its research projects (SEO) and the fields in which its research was undertaken (RFCD). For more information on these classifications see the *Australian Standard Research Classification (ASRC), 1998* (Cat. no. 1297.0).

CHAIN VOLUME MEASURES

19 The chain volume measures appearing in this publication are annually reweighted chain Laspeyres indexes referenced to the current price values in a chosen reference year (currently 1999–2000). They can be thought of as current price values re-expressed in (i.e. based on) the prices of the previous year and linked together to form continuous time series. They are formed in a multi-stage process of which the major steps are described in Section 15 of the information paper *Introduction of Chain Volume Measures in the Australian National Accounts* (Cat. no. 5248.0).

RELIABILITY OF STATISTICS

20 The statistics in this publication should be used with caution for the following reasons:

- many respondents made estimates because their accounts did not separately record data on R&D activity; and
- the OECD standard definition of R&D used in this survey differs in some respects from what data providers may regard as R&D activity. This is because the definitions used within the grants for industry R&D schemes (for the allocation of grants), and the R&D Tax Concession scheme (for tax deductibility for specific R&D activities) are slightly different from the international standard.

UNPUBLISHED STATISTICS

21 Limited additional detailed R&D statistics are available at a charge from the ABS.

RELATED PUBLICATIONS

22 Users may also wish to refer to the following publications:

Research and Experimental Development, All Sector Summary, Australia, 1998–99 (Cat. no. 8112.0)

Research and Experimental Development, Government and Private Non-Profit Organisations, Australia, 1998–99 (Cat. no. 8109.0)

Research and Experimental Development, Higher Education Organisations, Australia, 2000 (Cat no. 8111.0)

Main Science and Technology Indicators 2001-2, OECD, Paris, 2001

The Measurement of Scientific and Technological Activities ('Frascati Manual' 1993) OECD, Paris, 1994

23 Current publications issued by the ABS are listed in the *Catalogue of Publications and Products* (Cat. no. 1101.0). The ABS also issues, on Tuesdays and Fridays, a *Release Advice* (Cat. no. 1105.0) which lists publications to be released in the next few days. The Catalogue and Release Advice are available from any ABS office.

ROUNDING

24 Where figures have been rounded, discrepancies may occur between sums of the component items and totals.

GLOSSARY

Applied research Original work undertaken in order to acquire new knowledge with a specific application in view. It is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving some specific and predetermined objectives.

Basic research Experimental and theoretical work undertaken primarily to acquire new knowledge without a specific application in view. It consists of pure basic research and strategic basic research. Pure basic research is carried out without looking for long-term benefits other than the advancement of knowledge. Strategic basic research is directed into specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge for the solution of recognised practical problems.

Capital expenditure Expenditure on the acquisition of fixed tangible assets such as land, buildings, vehicles, plant, machinery and equipment attributable to R&D activity.

Chain volume measures Annually reweighted chain Laspeyres indexes referenced to the current price values in a chosen reference year (currently 1999–2000). They can be thought of as current price values re-expressed in (i.e. based on) the prices of the previous year and linked together to form continuous time series.

Experimental development Systematic work, using existing knowledge gained from research or practical experience, for the purpose of creating new or improved products/processes.

Extramural R&D R&D activity funded by an organisation but carried out by other businesses, organisations, institutions or individuals.

Human resources devoted to R&D The effort of researchers, technicians and other staff directly involved with R&D activity. Overhead staff (e.g. administrative and general service employees such as personnel officers, janitors, etc.) whose work indirectly supports R&D, are excluded.

Labour costs Wages and salaries, overtime allowances, penalty rates, leave loadings, bonuses, commission payments, all paid leave, employer contributions to superannuation and pension schemes, payroll tax, fringe benefits tax, payments to contract staff on the payroll, severance, termination and redundancy payments and workers compensation insurance.

Other current expenditure Expenditure on materials, fuels, rent and hiring, repairs and maintenance, data processing etc. and the proportion of expenditure on general services and overheads which is attributable to R&D activity.

Other supporting staff Skilled and unskilled craftpersons, secretarial and clerical staff directly associated with R&D activity.

R&D activity In the business context is systematic investigation or experimentation involving innovation or technical risk, the outcome of which is new knowledge, with or without a specific practical application or new or improved products, processes, materials, devices or services. R&D activity extends to modifications to existing products/processes. R&D activity ceases and pre-production begins when work is no longer experimental.

Researchers Those involved with the conception and/or development of new products/processes (e.g. executives and directors involved in the planning or management of scientific and technical aspects of R&D projects, and software developers/programmers). They exclude executives and directors concerned primarily with budgets and human resources rather then project content.

Research field Field in which the R&D activity was performed. The Research fields, courses and disciplines classification is primarily structured around disciplines or activities. It describes what research is being performed.

Socio-economic objective The area of expected national benefit rather than the immediate objectives of the researcher. The Socio-economic objective classification defines the main areas of Australian economic and social activity to which the results of research programs are applied. It describes the purpose of the research (i.e. why the research is being performed).

Technicians Those performing technical tasks in support of R&D activity, normally under the direction and supervision of a researcher. These tasks include preparation of experiments, taking records, preparation of charts and graphs and coding computer programs.

Type of R&D activity Comprises basic research, applied research and experimental development.

FOR MORE INFORMATION...

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2810400007008
ISSN 1442-5440

RRP $20.00

Produced by the Australian Bureau of Statistics