1997–98 8104.0

Australian Bureau of Statistics

RESEARCH & EXPERIMENTAL DEVELOPMENT BUSINESSES

AUSTRALIA

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■ For further information about these and related statistics, contact Kevin Squair on Canberra 02 6252 5707 or refer to the back cover of this publication.

NOTES

RESEARCH AND 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).

SYMBOLS AND OTHER USAGES

–	nil or rounded to zero
n.a	not available
n.e.c.	not elsewhere classified
n.p.	not available for separate publication (but included where applicable)
r	revised since previous issue
mfg	manufacturing

W. McLennan
Australian Statistician

MAIN FEATURES

EXPENDITURE ON R&D

For the second consecutive year, estimates of Business Expenditure on R&D (BERD) have fallen. In 1997–98 BERD at current prices was $4,044m, a decrease of 4% on 1996–97 and 7% on 1995–96. In volume terms, BERD was down 6% on 1996–97.

BERD as a percentage of Australia's Gross Domestic Product (GDP) also decreased from a high of 0.86% in 1995–96 to 0.72% in 1997–98. The BERD/GDP ratios of most other OECD countries increased between 1995–96 and 1997–98.

The change in BERD between 1996–97 and 1997–98 resulted from a reduction in total R&D expenditure by businesses which undertook R&D in both years, coupled with the reduction in expenditure resulting from businesses which ceased R&D exceeding the increase in expenditure by new R&D performers.

- Approximately 2,600 businesses undertook expenditure in both years; they incurred $3,893m of R&D in 1996–97 and $3,780m in 1997–98, a fall of 2.9%. Not all businesses reduced their expenditure in 1997–98; 43% of continuing R&D performers recorded increases in expenditure of 10% or more, while 25% recorded decreases of greater than 25%.
- Approximately 800 businesses which recorded $307m in 1996–97, did not report any R&D in 1997–98.
- Approximately 550 businesses which did not report R&D in 1996–97, recorded $264m in 1997–98.

The decrease in R&D expenditure is mainly attributable to Mining and Manufacturing industries. The Mining industry recorded a 24% decrease in expenditure, following a 4% increase the previous year. The Manufacturing industry recorded a 5% fall. Other industries (in total) recorded a 7% increase.

R&D expenditure in NSW, Victoria and WA fell by 5%, 1% and 23% respectively, while expenditure in SA increased by 19%.

HUMAN RESOURCES

Human resources devoted to R&D in 1997–98 were 24,420 person years, 8% lower than in 1996–97.

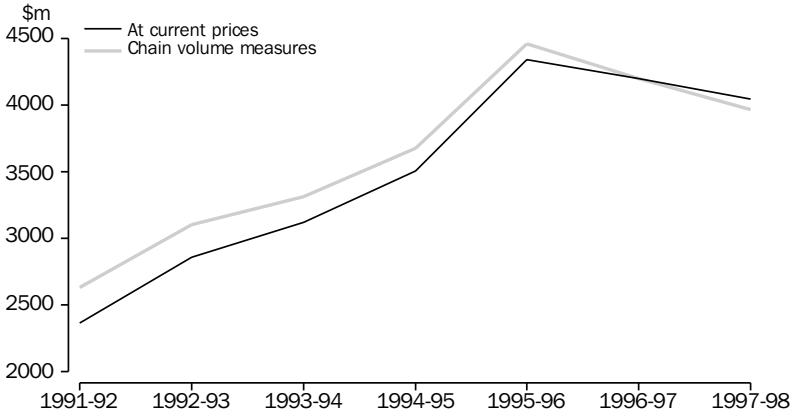
EXPECTED R&D

Businesses reported that they expected BERD to be $3,650m in 1998–99. This is 10% lower than the actual R&D expenditure incurred in 1997–98. However for 1996–97 and 1997–98, actual expenditure exceeded expectations by 10% and 4% respectively.

RESOURCES DEVOTED TO R&D

BERD has fallen in 1997–98 by 4% in current prices and 6% in volume terms from the levels of 1996–97, which were down on the record levels of 1995–96. These falls follow average annual rates of growth between 1991–92 and 1995–96 of 16% in current prices and 14% in volume terms.

EXPENDITURE ON R&D



Human resources devoted to R&D in 1997–98 were estimated to be 24,420 person years, a decrease of 8% on 1996–97 and 10% on 1995–96. Prior to these decreases, human resources devoted to research had, on average, increased annually from 1991–92 by 6%.

1 RESOURCES DEVOTED TO R&D(a)

	1991–92	*1992–93*	*1993–94*	*1994–95*	*1995–96*	*1996–97*	*1997–98*
	$m	$m	$m	$m	$m	$m	$m
Expenditure							
At current prices	2 364.5	2 861.9	3 119.2	r3 508.3	r4 343.1	r4 200.2	4 043.8
Chain volume measures(b)	2 633.8	3 103.6	3 313.1	3 678.8	4 460.2	4 200.2	3 968.8
	person years	person years	person years	person years	person years	person years	person years
Human resources	21 299	22 919	23 742	r25 812	r27 151	r26 483	24 420

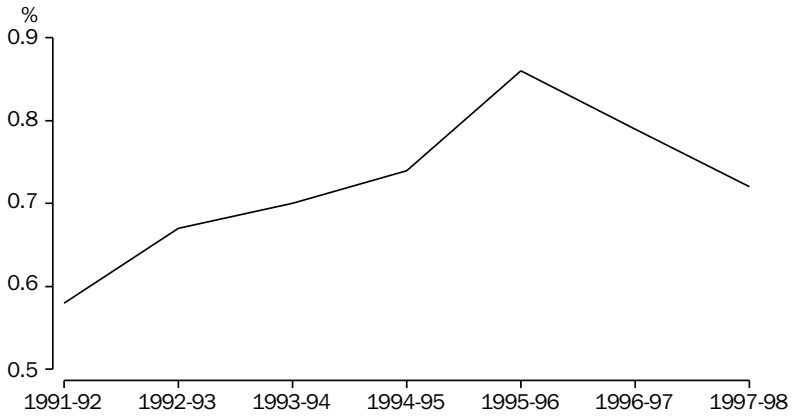
(a) Excludes businesses in ANZSIC Division A.

(b) Reference year for chain volume measures is 1996–97.

COMPARISON WITH GDP

Australia's BERD as a percentage of GDP decreased to 0.72% in 1997–98, down from a high of 0.86% in 1995–96. The falls follow significant increases between 1991–92 and 1995–96.

BERD AS A PERCENTAGE OF GDP



The BERD/GDP ratio remained relatively low when compared with other OECD countries as shown in the table below.

2 BERD/GDP RATIOS OF OECD COUNTRIES

	1995–96	*1996–97*	*1997–98*
Country	*%*	*%*	*%*
Korea	1.98	2.04	n.a.
Japan	1.94	2.01	n.a.
United States of America	1.88	1.92	1.96
Finland	1.49	1.71	1.88
Germany	1.53	1.51	1.63
France	1.43	1.43	1.38
Denmark	1.10	1.25	1.27
United Kingdom	1.32	1.26	n.a.
Netherlands	1.08	1.10	n.a.
Canada	0.97	0.99	1.04
Czech Republic	0.68	0.64	0.75
Australia	**0.86**	**0.79**	**0.72**
Italy	0.54	0.56	0.57
Iceland	0.49	0.47	0.56
Spain	0.41	0.42	0.44
Hungary	0.32	0.29	0.31
Poland	0.29	0.31	n.a.

INDUSTRY COMPARISON

Following a 4% increase in R&D expenditure in 1996–97 compared with 1995–96, the Mining industry decreased its expenditure by 24% in 1997–98 to $392m (10% of total R&D expenditure). The Mining industry's R&D human resources decreased by 11% on 1996–97 whilst accounting for 4% of total R&D human resources. The manufacturing industry's R&D expenditure declined by 5% on 1996–97 to $2,182m (54% of total R&D expenditure). Human resources devoted to R&D by the manufacturing industry decreased by 7% on 1996–97 and accounted for 56% of total R&D human resources. The Property and business services industry recorded an increase in R&D expenditure of 5% in comparison with 1996–97, although R&D human resources fell by 2%.

3 R&D, INDUSTRY OF BUSINESS(a)

		Businesses			*Expenditure on R&D*			*Human resources devoted to R&D*		
		1995–96r	*1996–97r*	*1997–98*	*1995–96r*	*1996–97r*	*1997–98*	*1995–96r*	*1996–97r*	*1997–98*
ANZSIC Code	*& Description*	*no.*	*no.*	*no.*	*$m*	*$m*	*$m*	*person years*	*person years*	*person years*
B	Mining (including services to mining)	129	108	104	498	517	392	1 079	1 069	947
Manufacturing										
21	Food, beverages and tobacco	189	171	147	291	232	179	1 330	1 341	1 051
22	Textile, clothing, footwear and leather	68	66	55	26	21	22	215	193	180
23	Wood and paper products	42	40	37	184	191	117	268	262	271
24	Printing, publishing and recorded media	49	39	39	23	17	19	246	168	184
25	Petroleum, coal, chemical and associated product	369	343	307	327	309	308	2 378	2 350	2 274
26	Non-metallic mineral product	84	77	61	82	66	72	376	483	461
27	Metal product	235	206	182	326	365	334	1 957	1 642	1 351
281–282	Motor vehicle and part and other transport equipment	142	127	122	415	401	436	2 459	2 704	2 674
283	Photographic and scientific equipment	106	100	95	131	91	93	1 134	868	900
284–285	Electronic and electrical equipment and appliance	387	360	326	389	423	442	2 969	3 135	2 943
286	Industrial machinery and equipment	292	283	245	128	144	123	1 263	1 292	1 159
29	Other manufacturing	95	78	73	16	46	36	202	199	208
C	*Total manufacturing*	*2 058*	*1 890*	*1 689*	*2 339*	*2 305*	*2 182*	*14 795*	*14 637*	*13 656*
Other industries										
F-G	Wholesale and retail trade	350	364	338	338	338	319	2 698	2 704	2 498
K	Finance and insurance	42	46	39	124	96	85	1 219	1 138	430
77,782–786	Property and business services	786	739	752	672	587	618	5 008	4 997	4 875
781	Scientific research	97	94	95	148	147	160	1 008	981	1 075
(b)	Other n.e.c.	174	179	178	223	210	289	1 344	958	939
D-Q	*Total other industries*	*1 449*	*1 422*	*1 402*	*1 505*	*1 378*	*1 470*	*11 277*	*10 777*	*9 817*
TOTAL ALL INDUSTRIES		**3 636**	**3 420**	**3 195**	**4 343**	**4 200**	**4 044**	**27 151**	**26 483**	**24 420**

(a) Excludes businesses in ANZSIC Division A.

(b) ANZSIC codes D, E, H-J, M-Q.

TYPE OF EXPENDITURE

In 1997–98, Labour costs accounted for $1,579m (39%) of the total R&D expenditure, a decrease of $15m compared with 1996–97. Other current expenditure at $2,010m (50%) was $64m lower than 1996–97, while Capital expenditure decreased by $77m on 1996–97 to account for $455m (11%).

The Mining industry had the lowest labour costs as a proportion of R&D expenditure (20%) and the Printing, publishing and recorded media industry had the highest (61%). The Metal product mfg industry had the highest capital expenditure ($71m) of all industries.

4 TYPE OF R&D EXPENDITURE(a)

ANZSIC Code & Description	*Total* $'000	*Capital expenditure* $'000	*Labour costs(b)* $'000	*Other current expenditure* $'000
B Mining (including services to mining)	392 000	56 619	80 266	255 115
Manufacturing				
21 Food, beverages and tobacco	178 540	22 547	69 895	86 097
22 Textile, clothing, footwear and leather	22 078	2 061	9 984	10 033
23 Wood and paper products	116 612	30 035	28 909	57 669
24 Printing, publishing and recorded media	19 146	n.p.	11 716	n.p.
25 Petroleum, coal, chemical and associated product	307 865	25 861	138 582	143 423
26 Non-metallic mineral product	72 388	10 091	25 915	36 382
27 Metal product	334 361	70 761	114 235	149 364
281–282 Motor vehicle and part and other transport equipment	436 243	49 184	150 355	236 705
283 Photographic and scientific equipment	93 230	4 580	52 252	36 399
284–285 Electronic and electrical equipment and appliance	441 685	21 303	179 778	240 604
286 Industrial machinery and equipment	123 489	7 924	64 038	51 527
29 Other manufacturing	35 927	n.p.	11 188	n.p.
C Total manufacturing	*2 181 564*	*264 232*	*856 847*	*1 060 485*
Other industries				
F-G Wholesale and retail trade	318 534	23 950	167 916	126 668
K Finance and insurance	84 854	10 563	33 847	40 444
77,782–786 Property and business services	618 345	54 392	311 792	252 162
781 Scientific research	159 980	13 051	67 479	79 450
(c) Other n.e.c.	288 542	32 377	60 757	195 408
D-Q Total other industries	*1 470 255*	*134 333*	*641 791*	*694 131*
TOTAL ALL INDUSTRIES	**4 043 819**	**455 183**	**1 578 905**	**2 009 731**

(a) Excludes businesses in ANZSIC Division A.

(b) Includes 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, severence, termination and redundancy payments and workers compensation insurance.

(c) ANZSIC codes D, E, H-J, M-Q.

SOURCE OF FUNDS FOR R&D

The business sector provided most of the R&D expenditure funds itself: 89% ($3,589m) was sourced from Own funds and 5% ($191m) from Other businesses. The Commonwealth Government provided $50m (1%) from Competitive grants for industry R&D and $42m (1%) from Other Commonwealth Government sources. Overseas funding provided $104m or 3%.

The Scientific research industry was the only industry that did not provide the bulk of R&D expenditure funding from Own funds (only 36%). A further 27% was provided by Other businesses with the Commonwealth Government providing another 15%.

5 SOURCE OF FUNDS FOR R&D(a)

ANZSIC Code & Description	Total	Own funds	Other businesses	Competitive Grants Scheme	Other C'wealth Gov't	State and Local Gov't	Other Aust(b)	Overseas
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
B Mining (including services to mining)	392 000	369 881	9 541	n.p.	—	n.p.	n.p.	n.p.
Manufacturing								
21 Food, beverages and tobacco	178 540	175 270	1 519	n.p.	—	n.p.	n.p.	—
22 Textile, clothing, footwear and leather	22 078	21 615	248	n.p.	—	—	—	n.p.
23 Wood and paper products	116 612	116 492	n.p.	n.p.	—	—	—	—
24 Printing, publishing and recorded media	19 146	18 382	177	587	—	—	—	—
25 Petroleum, coal, chemical and associated product	307 865	285 769	3 682	6 990	n.p.	80	n.p.	9 773
26 Non-metallic mineral product	72 388	71 230	n.p.	205	—	n.p.	—	—
27 Metal product	334 361	324 898	1 315	n.p.	5 141	n.p.	n.p.	n.p.
281–282 Motor vehicle and part and other transport equipment	436 243	413 264	2 372	50	n.p.	—	7 574	n.p.
283 Photographic and scientific equipment	93 230	80 669	3 665	n.p.	3 821	144	n.p.	244
284–285 Electronic and electrical equipment and appliance	441 685	371 507	54 139	7 124	1 358	n.p.	n.p.	n.p.
286 Industrial machinery and equipment	123 489	114 210	4 384	1 831	57	n.p.	852	n.p.
29 Other manufacturing	35 927	33 500	n.p.	1 873	n.p.	—	—	—
C Total manufacturing	*2 181 564*	*2 026 806*	*73 017*	*22 881*	*12 156*	*2 664*	*18 120*	*25 919*
Other industries								
F-G Wholesale and retail trade	318 534	284 633	5 188	6 090	n.p.	n.p.	100	17 003
K Finance and insurance	84 854	n.p.	—	n.p.	—	—	—	—
77,782–786 Property and business services	618 345	497 921	49 253	9 926	10 653	1 114	10 640	38 837
781 Scientific research	159 980	58 358	43 537	8 622	14 630	998	22 642	11 194
(c) Other n.e.c.	288 542	n.p.	10 488	1 633	n.p.	607	n.p.	n.p.
D-Q Total other industries	*1 470 255*	*1 192 269*	*108 466*	*n.p.*	*30 263*	*n.p.*	*n.p.*	*n.p.*
TOTAL ALL INDUSTRIES	**4 043 819**	**3 588 956**	**191 024**	**49 680**	**42 420**	**6 309**	**61 320**	**104 110**

(a) Excludes businesses in ANZSIC Division A.

(b) Includes Higher Education and Private Non-profit sectors.

(c) ANZSIC codes D, E, H-J, M-Q.

STATE COMPARISONS

The leading States in terms of R&D expenditure were Victoria with $1,443m and New South Wales with $1,413m, accounting for 36% and 35% of total R&D expenditure respectively. Queensland recorded $437m (11%) while Western Australia with $384m (9%) had the next highest R&D expenditure.

Compared to 1996–97, R&D expenditure decreased in New South Wales by $73m, in Victoria by $13m and in Western Australia by $112m. In South Australia expenditure increased by $36m, while expenditure in Queensland remained the same.

In the Mining industry, Western Australia accounted for $118m (30%), New South Wales $115m (29%) and Queensland $80m (20%).

Major contributors to R&D in the Manufacturing industry were Victoria $817m (37%) and New South Wales $747m (34%).

6 LOCATION OF R&D EXPENDITURE(a)(b)

ANZSIC Code & Description		Total	Location of expenditure: NSW	Vic.	Qld	SA	WA	Other Aust. States and Territories	Overseas
		$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
B	Mining (including services to mining)	392 000	115 489	32 067	79 509	n.p.	117 744	11 498	n.p.
Manufacturing									
21	Food, beverages and tobacco	178 540	84 701	60 194	17 550	2 982	10 988	1 707	417
22	Textile, clothing, footwear and leather	22 078	7 011	10 684	n.p.	1 314	1 047	n.p.	n.p.
23	Wood and paper products	116 612	12 923	n.p.	12 166	2 491	n.p.	n.p.	n.p.
24	Printing, publishing and recorded media	19 146	5 673	10 545	n.p.	750	n.p.	714	n.p.
25	Petroleum, coal, chemical and associated product	307 865	121 616	130 680	24 099	13 149	12 685	4 144	1 492
26	Non-metallic mineral product	72 388	39 619	7 575	7 317	n.p.	11 911	2 641	n.p.
27	Metal product	334 361	98 745	92 608	82 910	6 064	n.p.	n.p.	n.p.
281–282	Motor vehicle and part and other transport equipment	436 243	27 734	297 005	10 874	n.p.	n.p.	n.p.	n.p.
283	Photographic and scientific equipment	93 230	43 144	n.p.	6 345	n.p.	1 905	1 215	n.p.
284–285	Electronic and electrical equipment and appliance	441 685	251 698	77 964	38 820	39 030	30 990	2 187	996
286	Industrial machinery and equipment	123 489	47 717	32 784	20 676	5 860	10 332	3 396	2 724
29	Other manufacturing	35 927	5 962	22 494	2 659	3 499	771	489	53
C	*Total manufacturing*	*2 181 564*	*746 543*	*817 103*	*225 439*	*133 540*	*191 760*	*53 383*	*13 796*
Other industries									
F-G	Wholesale and retail trade	318 534	91 612	159 052	20 526	34 817	10 173	1 883	471
K	Finance and insurance	84 854	36 591	37 672	n.p.	—	9 813	—	n.p.
77,782–786	Property and business services	618 345	310 514	163 676	57 359	16 279	38 331	28 800	3 387
781	Scientific research	159 980	58 917	60 530	20 156	8 386	8 317	667	3 008
(c)	Other n.e.c.	288 542	53 653	173 351	n.p.	n.p.	7 852	10 858	1 045
D-Q	*Total other industries*	*1 470 255*	*551 286*	*594 280*	*131 611*	*n.p.*	*74 486*	*42 207*	*n.p.*
TOTAL ALL INDUSTRIES		**4 043 819**	**1 413 318**	**1 443 450**	**436 558**	**232 771**	**383 990**	**107 088**	**26 644**

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

(b) Excludes businesses in ANZSIC Division A.

(c) ANZSIC codes D, E, H-J, M-Q.

EXPENDITURE BY SIZE OF BUSINESS

The largest businesses, employing 1000 or more, accounted for 36% of total R&D expenditure (35% in 1996–97). On average this was more than $10m per business undertaking R&D. Businesses employing less than ten people accounted for only 4% of the R&D (5% in 1996–97). This averaged out at approximately $177,000 for each business undertaking R&D.

The ABS defines small business as those employing less than 100 in Manufacturing industries and less than 20 in other industries. Small businesses accounted for 26% of Manufacturing R&D and 13% of R&D in other industries.

7 EXPENDITURE ON R&D, BY SIZE OF BUSINESS(a)(b)

			Business employment size							
		Total	*Less than 10*	*10–19*	*20–49*	*50–99*	*100–199*	*200–499*	*500–999*	*1000 or more*
ANZSIC Code	*& Description*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*
B	Mining (including services to mining)	392 000	2 919	6 997	16 166	8 656	55 315	69 552	86 327	146 068
Manufacturing										
21	Food, beverages and tobacco	178 540	n.p.	n.p.	9 931	16 915	9 534	22 543	18 127	93 306
22	Textile, clothing, footwear and leather	22 078	n.p.	n.p.	3 110	3 040	5 899	3 045	5 032	—
23	Wood and paper products	116 612	278	n.p.	469	n.p.	854	3 483	7 940	103 471
24	Printing, publishing and recorded media	19 146	1 368	2 913	1 584	7 561	n.p.	n.p.	n.p.	n.p.
25	Petroleum, coal, chemical and associated product	307 865	7 369	10 891	25 651	55 604	22 987	70 268	49 223	65 872
26	Non-metallic mineral product	72 388	1 046	2 073	2 418	1 249	4 977	5 305	18 603	36 717
27	Metal product	334 361	3 028	n.p.	45 250	6 975	8 154	n.p.	16 476	78 155
281–282	Motor vehicle and part and other transport equipment	436 243	2 081	4 996	5 048	6 976	17 539	63 056	39 300	297 247
283	Photographic and scientific equipment	93 230	5 286	6 537	n.p.	4 613	5 774	42 617	10 691	n.p.
284–285	Electronic and electrical equipment and appliance	441 685	16 342	44 124	28 299	24 195	55 204	101 116	71 497	100 908
286	Industrial machinery and equipment	123 489	5 512	14 620	20 111	18 312	11 975	14 948	13 152	24 859
29	Other manufacturing	35 927	4 070	3 590	n.p.	n.p.	n.p.	1 421	n.p.	—
C	*Total manufacturing*	*2 181 564*	*53 793*	*188 211*	*174 854*	*148 510*	*143 383*	*408 675*	*254 651*	*809 487*
Other industries										
F-G	Wholesale and retail trade	318 534	12 365	13 316	35 164	20 726	23 578	62 486	18 906	131 994
K	Finance and insurance	84 854	1 686	—	16 033	1 166	n.p.	n.p.	16 492	43 137
77,782–786	Property and business services	618 345	69 262	63 680	90 708	96 709	100 233	56 656	13 831	127 266
781	Scientific research	159 980	13 633	30 902	48 960	60 104	n.p.	n.p.	—	—
(c)	Other n.e.c.	288 542	10 127	9 135	21 402	9 009	6 643	7 306	7 281	217 639
D-Q	*Total other industries*	*1 470 255*	*107 073*	*117 033*	*212 267*	*187 714*	*133 829*	*135 794*	*56 510*	*520 036*
TOTAL ALL INDUSTRIES		**4 043 819**	**163 785**	**312 241**	**403 286**	**344 880**	**332 527**	**614 021**	**397 488**	**1 475 591**

(a) Excludes businesses in ANZSIC Division A.

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

(c) ANZSIC codes D, E, H-J, M-Q.

DIRECTIONS OF R&D EFFORT

Computer software accounted for $762m (19%) of R&D effort in 1997–98. The next largest product areas were Mining products ($432m, 11%), Electronic equipment ($395m, 10%), Motor vehicles and parts ($363m, 9%) and Pharmaceutical and veterinary products ($242m, 6%).

8 PRODUCT FIELD(a) OF R&D EXPENDITURE(b)

	Businesses(c)		*Expenditure on R&D*	
	1994–95	*1997–98*	*1994–95*	*1997–98*
Product field	*no.*	*no.*	*$'000*	*$'000*
Agriculture, forestry, fishing and hunting	146	150	58 199	72 089
Mining	219	191	265 168	432 112
Manufacturing				
Food and beverages	207	169	119 700	148 522
Textiles, clothing and footwear	70	66	23 980	21 232
Wood, wood products and furniture	75	55	28 907	25 712
Paper, paper products, publishing and printing	61	54	64 813	93 204
Petroleum refining	41	8	12 977	n.p.
Pharmaceutical and veterinary products	113	121	192 514	241 846
Rubber and plastic products	108	144	49 913	46 802
Other industrial chemical products	197	148	147 944	n.p.
Non-metallic mineral products	58	36	28 587	47 709
Basic iron and steel	42	42	198 077	93 738
Basic non-ferrous metals	38	43	101 420	131 874
Fabricated metal products	279	181	103 922	125 147
Industrial machinery and equipment	406	397	126 511	175 890
Computer hardware	195	183	60 001	78 263
Electronic equipment	310	315	335 865	394 546
Other electrical appliances, machinery and equipment	177	137	76 425	74 689
Photographic, professional and scientific equipment	103	82	79 282	69 564
Motor vehicles and parts	129	113	274 782	363 054
Ships and boats	46	33	n.p.	58 723
Railway rolling stock and locomotives	34	26	n.p.	24 172
Aircraft	30	21	11 863	6 796
Other transport equipment	69	39	15 386	15 232
Other manufactured products	318	245	101 302	115 144
Total manufacturing	*2 370*	*2 157*	*2 236 114*	*2 452 044*
Other industries				
Computer software	816	874	699 216	761 761
Construction	101	57	20 590	16 639
Electricity, gas and water	n.a.	81	n.a.	57 632
Transport and storage services	n.a.	33	n.a.	11 724
Telecommunication services	n.a.	58	n.a.	157 836
Other n.e.c.	n.a.	173	n.a.	81 982
Total other industries	*1 174*	*1 150*	*948 855*	*1 087 574*
Total all industries	**3 389**	**3 195**	**3 508 337**	**4 043 819**

(a) The industry of product (or process) field towards which the R&D was directed. For further explanation see paragraph 17 of the Explanatory Notes.

(b) Excludes businesses in ANZSIC Division A.

(c) Where the R&D performed was directed towards more than one product, the business is counted in each of the product fields to which its products are coded. Therefore, the business counts shown in this table cannot be summed to aggregates for combinations of product fields.

FIELD OF RESEARCH

Almost all the R&D expenditure took place in the Natural sciences, technologies and engineering. Of this, 15% was in Manufacturing and process technologies and engineering, 13% in Computer software, 11% in Communications technologies and 11% in Mechanical and industrial engineering.

9 RESOURCES DEVOTED TO R&D, BY FIELD OF RESEARCH(a)

		Type of expenditure			
	Total	Capital expenditure	Labour costs(b)	Other current expenditure	Human resources
Field of research	*$'000*	*$'000*	*$'000*	*$'000*	*person years*
Natural sciences, technologies and engineering					
Mathematical sciences	11 729	1 203	5 048	5 477	74
Physical sciences	41 138	3 548	20 021	17 569	282
Chemical sciences	138 376	14 248	61 526	62 603	945
Earth sciences	139 470	13 200	44 179	82 091	513
Information systems and technologies	187 060	15 525	102 425	69 111	1 428
Computer software	534 548	32 040	299 877	202 631	4 726
Communications technologies	437 648	20 906	134 137	282 605	1 908
Other information, computers and communication technologies	163 400	19 589	65 317	78 494	983
Manufacturing and process technologies and engineering	606 554	100 954	187 774	317 826	2 877
Industrial biotechnology and food sciences	112 110	18 624	47 385	46 101	707
Material sciences and technologies	187 011	19 743	72 001	95 267	1 019
Other applied sciences and technologies	107 234	8 363	49 775	49 096	845
Mechanical and industrial engineering	425 562	36 330	170 826	218 407	2 994
Mining and mineral processing	296 266	55 303	52 107	188 857	660
Other general engineering	310 705	69 795	126 950	113 960	2 166
Biological sciences	60 000	2 167	25 203	32 629	376
Agricultural sciences	83 294	9 419	36 355	37 521	619
Medical and health sciences	194 035	13 586	73 174	107 274	1 209
Total natural sciences, technologies and engineering	*4 036 140*	*454 543*	*1 574 080*	*2 007 518*	*24 331*
Social sciences and humanities					
Social sciences	6 205	524	3 945	1 736	69
Humanities	1 473	117	879	477	20
Total social sciences and humanities	*7 678*	*640*	*4 825*	*2 213*	*89*
Total	**4 043 819**	**455 183**	**1 578 905**	**2 009 731**	**24 420**

(a) Excludes businesses in ANZSIC Division A.

(b) Includes 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.

EXPECTED R&D EXPENDITURE

The 'actual' data in the table below are the R&D business expenditures reported in the 1995–96, 1996–97 and 1997–98 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 1996–97,1997–98 and 1998–99 'expected' data in the table.

These estimates should be used with caution because:

- only some businesses have long-term R&D projects and can provide a fairly accurate forecast; and
- many businesses perform R&D on a 'needs be' basis or have projects nearing completion. For these businesses any forecast expenditure is a best guess.

10 EXPECTED AND ACTUAL EXPENDITURE ON R&D(a)

	1995–96r		*1996–97r*		*1997–98*	*1998–99*
	Actual	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*
ANZSIC Code & Description	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*	*$'000*
B Mining (including services to mining)	498 420	401 254	516 689	390 089	392 000	266 768
Manufacturing						
21 Food, beverages and tobacco	291 461	206 380	231 908	208 669	178 540	163 133
22 Textile, clothing, footwear and leather	25 694	20 162	21 350	20 752	22 078	20 345
23 Wood and paper products	184 346	70 982	191 353	96 309	116 612	111 627
24 Printing, publishing and recorded media	22 659	24 009	16 508	13 598	19 146	17 832
25 Petroleum, coal, chemical and associated product	327 449	308 398	309 135	348 662	307 865	288 622
26 Non-metallic mineral product	81 938	53 214	65 539	59 739	72 388	53 060
27 Metal product	325 725	309 641	365 186	416 068	334 361	250 327
281–282 Motor vehicle and part and other transport equipment	415 385	386 537	400 925	325 793	436 243	393 006
283 Photographic and scientific equipment	131 352	113 719	90 868	95 763	93 230	90 925
284–285 Electronic and electrical equipment and appliance	388 573	377 040	423 143	394 018	441 685	425 684
286 Industrial machinery and equipment	128 318	123 226	143 698	126 267	123 489	119 313
29 Other manufacturing	16 469	15 799	45 841	33 666	35 927	24 930
C Total manufacturing	*2 339 369*	*2 009 105*	*2 305 454*	*2 139 304*	*2 181 564*	*1 958 804*
Other industries						
F-G Wholesale and retail trade	338 123	356 151	338 065	341 351	318 534	340 563
K Finance and insurance	123 913	119 180	96 117	71 935	84 854	77 515
77,782–786 Property and business services	671 809	579 470	586 700	582 849	618 345	588 823
78 Scientific research	148 248	148 443	146 766	167 515	159 980	173 912
(b) Other n.e.c.	223 194	215 961	210 429	183 814	288 542	243 360
D-Q Total other industries	*1 505 287*	*1 419 205*	*1 378 077*	*1 347 464*	*1 470 255*	*1 424 174*
Total	**4 343 076**	**3 829 564**	**4 200 219**	**3 876 857**	**4 043 819**	**3 649 745**

(a) Excludes businesses in ANZSIC Division A.

(b) ANZSIC codes D, E, H-J, M-Q.

HUMAN RESOURCES BY SIZE OF BUSINESS

Businesses employing 1,000 or more contributed 27% of human resource effort. However only 1% of their total employment was devoted to R&D. Businesses with less than 10 employees devoted 42% of their total employment to research, although this only contributed 7% of the total resources undertaking R&D.

Using the ABS definitions (see page 10) small businesses contributed 29% of human resources to R&D in Manufacturing and 21% in other industries.

11 HUMAN RESOURCES DEVOTED TO R&D, BY SIZE OF BUSINESS(a)(b)

			BUSINESS EMPLOYMENT SIZE							
		Total	Less than 10	10–19	20–49	50–99	100–199	200–499	500–999	1000 or more
ANZSIC Code	& Description	person years	person years	person years	person years	person years	person years	person years	person years	person years
B	Mining (including services to mining)	947	13	42	54	13	166	222	189	249
Manufacturing-										
21	Food, beverages and tobacco	1 051	10	13	62	125	90	104	146	502
22	Textile, clothing, footwear and leather	180	n.p.	n.p.	22	35	47	31	26	—
23	Wood and paper products	271	9	n.p.	5	n.p.	9	30	38	178
24	Printing, publishing and recorded media	184	15	37	17	88	3	n.p.	n.p.	n.p.
25	Petroleum, coal, chemical and associated product	2 274	60	83	224	359	219	538	314	478
26	Non-metallic mineral product	461	15	24	23	20	32	24	95	228
27	Metal product	1 351	22	118	139	n.p.	62	n.p.	105	339
281–282	Motor vehicle and part and other transport equipment	2 674	32	43	55	61	185	291	381	1 626
283	Photographic and scientific equipment	900	63	78	139	33	n.p.	354	88	n.p.
284–285	Electronic and electrical equipment and appliance	2 943	202	259	330	256	385	577	381	551
286	Industrial machinery and equipment	1 159	62	108	177	205	97	146	101	263
29	Other manufacturing	208	n.p.	26	58	50	n.p.	16	n.p.	—
C	*Total manufacturing*	*13 656*	*532*	*805*	*1 251*	*1 315*	*1 191*	*2 595*	*1 708*	*4 260*
Other industries-										
F-G	Wholesale and retail trade	2 498	161	161	339	223	213	430	124	847
K	Finance and insurance	430	12	—	57	20	n.p.	n.p.	70	200
77,782–786	Property and business services	4 875	783	709	858	685	757	279	151	652
781	Scientific research	1 075	97	151	355	442	n.p.	n.p.	—	—
(c)	Other n.e.c.	939	77	78	117	25	44	97	45	456
D-Q	*Total other industries*	*9 817*	*1 130*	*1 099*	*1 726*	*1 396*	*1 067*	*855*	*390*	*2 155*
TOTAL ALL INDUSTRIES		**24 420**	**1 675**	**1 946**	**3 031**	**2 723**	**2 424**	**3 671**	**2 286**	**6 664**

(a) Excludes businesses in ANZSIC Division A.

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

(c) ANZSIC codes D, E, H-J, M-Q.

TYPE OF HUMAN RESOURCES

Researchers comprised 59% of the human resources devoted to R&D, followed by Technicians with 27% and Other supporting staff with 14%. In Mining, Researchers accounted for 47% and Technicians 24%. Researchers made up 55% in Manufacturing with 30% by Technicians. Within the Manufacturing industries, the proportion by Researchers ranged from a high of 68% in Electronic and electrical equipment and appliance to a low of 41% in Wood and paper products. Other industries had a high proportion of Researchers with 65%. Within Other industries, Wholesale and Retail trade had 66% Researchers, Property and business services 66%, Finance and insurance 63% and Scientific research 63%.

12 HUMAN RESOURCES DEVOTED TO R&D, BY TYPE OF EMPLOYEE(a)

ANZSIC Code & Description	*Total* person years	*Researchers* person years	*Technicians* person years	*Other supporting staff* person years
B Mining (including services to mining)	947	444	232	271
Manufacturing				
21 Food, beverages and tobacco	1 051	594	281	176
22 Textile, clothing, footwear and leather	180	76	57	47
23 Wood and paper products	271	112	107	53
24 Printing, publishing and recorded media	184	111	62	11
25 Petroleum, coal, chemical and associated product	2 274	1 238	698	338
26 Non-metallic mineral product	461	222	146	93
27 Metal product	1 351	726	415	211
281–282 Motor vehicle and part and other transport equipment	2 674	1 179	1 018	477
283 Photographic and scientific equipment	900	574	256	70
284–285 Electronic and electrical equipment and appliance	2 943	1 991	657	295
286 Industrial machinery and equipment	1 159	595	306	258
29 Other manufacturing	208	102	59	48
C Total manufacturing	*13 656*	*7 518*	*4 062*	*2 076*
Other industries				
F-G Wholesale and retail trade	2 498	1 646	633	220
K Finance and insurance	430	273	121	35
77,782–786 Property and business services	4 875	3 241	1 110	524
781 Scientific research	1 075	673	271	132
(b) Other n.e.c.	939	540	256	143
D-Q Total other industries	*9 817*	*6 373*	*2 391*	*1 054*
TOTAL ALL INDUSTRIES	**24 420**	**14 335**	**6 684**	**3 401**

(a) Excludes businesses in ANZSIC Division A.

(b) ANZSIC codes D, E, H-J, M-Q.

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 1997–98.

2 For details of R&D statistics available for the General government, Private non-profit and Higher education sectors see paragraph 27.

DATA SOURCES

3 The 1997–98 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 1998. This survey was based on a complete enumeration of businesses identified by the Australian Bureau of Statistics (ABS) as likely R&D performers. The survey was conducted by mailed questionnaires and a 93% response was obtained. The ABS believes that the non-respondents were non-R&D performers.

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, December Quarter 1998 (Cat. no. 5206.0)) and, at current prices, are as follows: $404,886m (1991–92); $425,825m (1992–93); $448,284m (1993–94); $473,463m (1994–95); $507,527m (1995–96); $531,045m (1996–97) and $563,517m (1997–98). 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, 1998–2, OECD, Paris, 1999.

STATISTICAL UNIT

5 For businesses, the unit from which information is 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 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

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

9 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.

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

COVERAGE

11 The 1997–98 R&D survey comprised a complete enumeration of businesses identified by the ABS as likely to have carried out R&D activity.

12 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).

13 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 125% Tax Concession and Competitive Grants for Industry R&D; or
- businesses identified from reports in newspapers, industrial journals, research compendia etc. as likely to have R&D activity.

14 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

15 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)*.

16 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.

PRODUCT FIELD

17 Business sector R&D expenditure presented in table 8 are classified by product (or process) field. This involved asking each business to apportion its total R&D expenditure towards the products/processes to which it was directed. For example, a business classified as being in mining may have performed R&D activity into a more efficient ore crusher. This R&D expenditure would be classified to the Industrial machinery and equipment product field.

FIELD OF RESEARCH CLASSIFICATION

18 Statistics of business R&D classified by Field of research (FOR) have been collected and presented in this publication. Each business undertaking R&D was asked to categorise its R&D expenditure according to the fields in which its research was undertaken. For more information on the FOR classification see the *Australian Standard Research Classification (ASRC), 1993* (Cat. no. 1297.0).

CHAIN VOLUME MEASURES

19 Constant price estimates have been replaced with chain volume estimates from this issue.

20 Chain volume measures have been introduced because they provide a better measure of growth in volume than existing constant price estimates. To understand this it is necessary to briefly explain how constant price estimates are derived.

21 While current price estimates of research and development expenditure reflect both price and volume changes, constant price estimates eliminate the direct effect of price changes and therefore only reflect volume changes. Although expressed in monetary terms, the constant price measures vary only with changes in the underlying quantities of inputs purchased (including labour). In effect, quantities of broadly defined categories of inputs are weighted by their prices in the base year. Because the measures relate to input quantities, they do not reflect changes in the efficiency with which labour, capital and other inputs are used.

22 Changes in price relativities adversely affect the usefulness of constant price estimates, particularly for periods distant from the base year, and consequently the base year used to derive constant price estimates needs to be changed from time to time. It has been ABS practice to change the base year every five years, but it has been found that better estimates of growth in volume can be obtained by rebasing every year and linking the resulting indexes to form annually reweighted chain volume measures.

23 The impact of the change from constant price estimates to chain volume measures largely depends on the extent of differences in growth rates between the prices and volumes of the components of particular series. In the case of research and development expenditure, the introduction of chain volume measures has had little effect on growth rates over time.

CHAIN VOLUME MEASURES *continued*

24 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 1996–97). 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

25 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 Competitive Grants for Industry R&D scheme (for the allocation of grants), and the 125% Tax Concession scheme (for tax deductibility for specific R&D activities) are slightly different from the international standard.

UNPUBLISHED STATISTICS

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

RELATED PUBLICATIONS

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

ABS publications

Research and Experimental Development, All Sector Summary, Australia, 1996–97 (Cat. no. 8112.0)

Research and Experimental Development, General Government and Private Non-Profit Organisations, Australia, 1996–97 (Cat. no. 8109.0)

Research and Experimental Development, Higher Education Organisations, Australia, 1996 (Cat no. 8111.0)

Non-ABS publications

Main Science and Technology Indicators 1998–2, OECD, Paris, 1999

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

28 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

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

GLOSSARY

BERD-Business expenditure on R&D The sum of intramural R&D expenditures incurred by all businesses in the survey.

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

Field of research Field in which the R&D activity was performed. The FOR classification is primarily structured around disciplines or activities. It describes what research is being performed.

FOR Field of research

GDP Gross Domestic Product

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.

Intramural R&D R&D carried out by an organisation on its own behalf or on the behalf of other businesses, organisations, institutions or individuals.

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.

OECD Organisation for Economic Co-operation and Development.

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 Research and Development.

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 executive and directors concerned primarily with budgets and human resources rather then project content.

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.

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DIAL-A-STATISTIC For current and historical Consumer Price Index data, call 1902 981 074.
For the latest figures for National Accounts, Balance of Payments, Labour Force, Average Weekly Earnings, Estimated Resident Population and the Consumer Price Index call 1900 986 400.
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POST Client Services, ABS, PO Box 10, Belconnen ACT 2616

EMAIL client.services@abs.gov.au

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