New Zealand research & experimental development statistics : all sectors, 1995/96 / Ministry of Research, Science and Technology.

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& TECHNOLOGY

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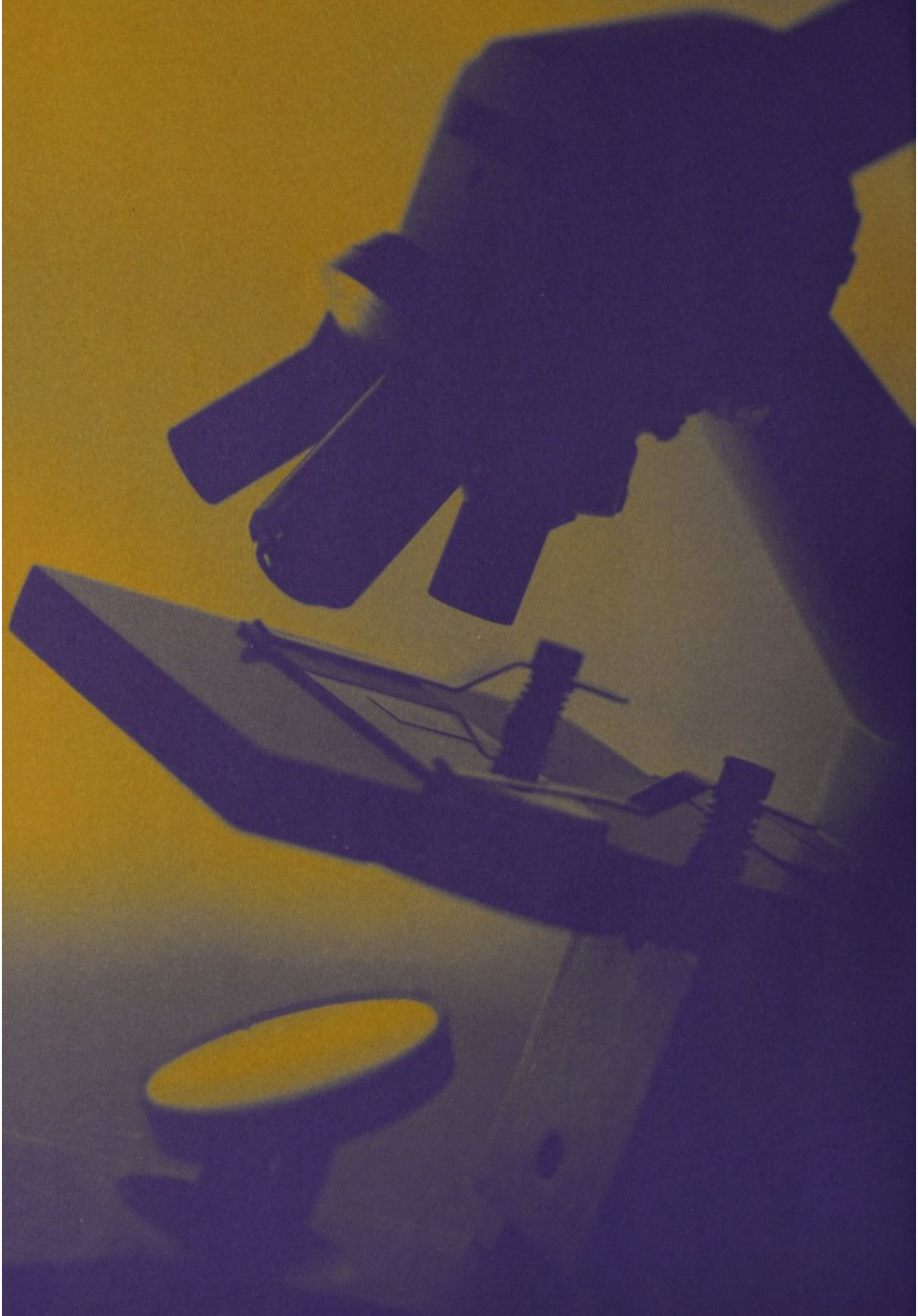
This document is the report of the joint survey of business and government sector R&D carried out by the Ministry of Research, Science and Technology and Statistics New Zealand, and the Ministry's own survey of R&D in the higher education sector.

Approved for general release

James Buwalda
Chief Executive



FOREWORD

Frank Edwards
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This survey of research and development (R&D) is the sixth in a series of R&D surveys to be undertaken by the Ministry of Research, Science and Technology. It was carried out jointly with Statistics New Zealand. It will provide valuable information to policy makers in government and business.

The process for carrying out these R&D expenditure surveys was developed with the assistance of an advisory group whose members were drawn from key sectors of the science and science user communities.

The government and business sectors were generally very willing to provide the information and to participate in the survey. I would like to thank Ron Maddox and Rob Tinkler at Statistics New Zealand who managed, along with this Ministry, the queries and checks which a complex and technical survey of this nature generated. Universities were surveyed by the Ministry for the third time in this series (following the 1993 pilot survey), in conjunction with the New Zealand Vice-Chancellors' Committee.

The value of this information on R&D increases the longer the time frame over which it is collected. It is therefore the intention to repeat this survey at least every two years. The Ministry recognises that R&D is only one element of a complex process of knowledge creation, distribution and use. We will therefore continue to develop new science and technology (S&T) indicators to improve the ability to address S&T policy development and monitoring issues, particularly from an outcome focus. Specific areas include innovativeness and economic competitiveness, S&T human resources and capability, and values and attitudes towards S&T.

Frank Edwards

Frank Edwards

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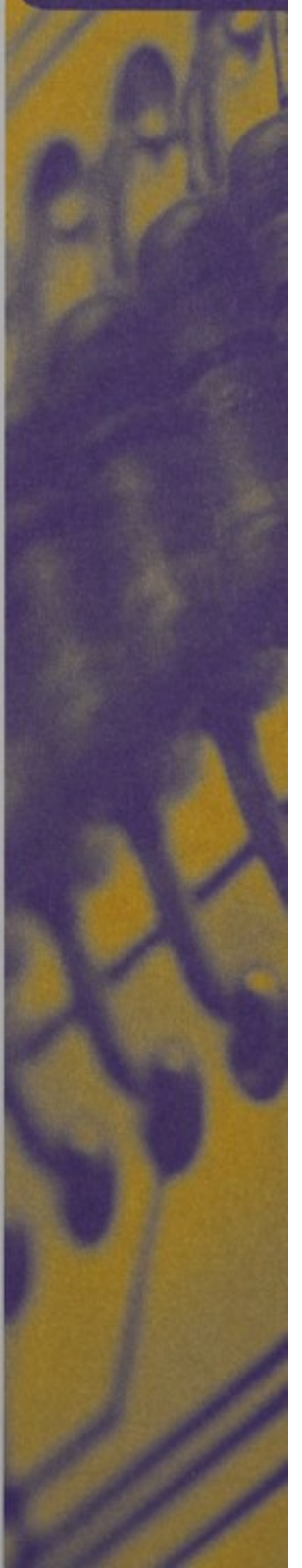

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EXECUTIVE SUMMARY

This report documents the sixth annual survey of research and development (R&D) undertaken in New Zealand*.

New Zealand's gross domestic R&D expenditure in 1995/96 was $889 million, an increase of 7.8% from $825 million in 1994/95. This represented 0.99% of the country's Gross Domestic Product (GDP) in 1995/96, a decline from 1.02% of GDP in 1993/94. The corresponding average rate of expenditure on R&D in 1995 for six OECD reference countries (see Introduction, section E) was 1.89% of GDP, almost double the rate of investment in R&D in New Zealand.

Since 1990/91, R&D expenditure in New Zealand has increased by almost $250 million, or by about 40%. This is an annual compound growth rate of 6.8% per year, and exceeds the annual compound growth rate for New Zealand's GDP during this time of just over 4.0%. In the other OECD countries R&D expenditure has grown slightly slower than in New Zealand, averaging 6.5% per year during this same time, while GDP has grown more rapidly at an average of 5.3% per year.

R&D carried out by the private sector was $240 million. This represented 0.27% of GDP, or 27% of the total R&D carried out in New Zealand. For the OECD reference countries, business sector R&D was 1.13% of GDP, or 60% of total R&D. The government sector carried out R&D of $375 million, or 0.42% of GDP, while university R&D totalled $273 million, or 0.30% of GDP. Together, the latter two sectors carried out an R&D expenditure of 0.72% of GDP. This compares with an average of 0.76% of GDP for government and university sectors in the OECD reference countries.

R&D carried out by the business sector decreased by $7.6 million in 1995/96, a reduction of 3.1%. This is the first decrease since 1990/91, and was due primarily to a sharp reduction in some R&D projects in the information and communications sector. However, business sector funding of R&D increased from $279.2 million in 1993/94 to $299.2 million in 1995/96 (excludes business funding of R&D performed overseas), an increase of 7.1%. A significant increase was reported in business funding of R&D undertaken both by the government (primarily Crown Research Institutes) and the university sectors.

R&D carried out by the government sector increased by $32 million, or 9.3% over 1993/94. Research into primary production increased by almost 30% and in the processing of primary products by 7%. Research into materials engineering, infrastructure, and the environment, exploration and assessment of the earth decreased by $20 million or 13%.

** Explanatory note: For the purposes of the R&D survey, all research providers are grouped into one of three sectors: the business, government and university sectors. Information about R&D expenditure and personnel is reported here according to the sector in which the research was carried out, not by the sector which funded the research. Exceptions are Tables 16 and 20, which provide estimates of business and government funding of R&D.*

Research carried out in a sector is known as the intramural R&D expenditure of the sector. This is the statistic most commonly used in OECD comparisons. R&D funded by each sector is a different statistic, obtained by splitting intramural R&D expenditure for each sector by its source of funds and adding total funding from each source across the three provider sectors, as in Table 23.

R&D performed by businesses was concentrated in: primary product processing (37%); materials, engineering and telecommunications (23%); and infrastructure and services, including software R&D (16%). Government R&D was concentrated in: primary production (49%); and environment and natural resources (25%).These results illustrate the focus of business R&D on secondary industry and of government R&D on primary production.

R&D carried out by the higher education sector increased by $40 million or 17.1%. Research in the medical and health sciences took 27.5% of university R&D expenditure, followed by the social sciences, 23.5%, and biological sciences, 9.5%. The natural sciences (physics, chemistry, biological and earth sciences) taken together amounted to 21.8% of university R&D expenditure.

Thirty-one percent of the funding for university research came from external sources. It is estimated that a further 46% came from general university funds from Government, and 23% from the universities' own funds, which included student fees.

Total government sector funding for R&D increased from $452 million in 1993/94 to $467 million in 1995/96 (including part of the EFTS funding to universities), an increase of 3.3%. Universities also funded $75 million of R&D from their own funds in 1995/96 (including money from student fees), up 34% from $56 million in 1993/94.

Of the total of $889 million research carried out in New Zealand, $12.1 million was paid for with funds from overseas and $14.4 million with private non-profit funds.

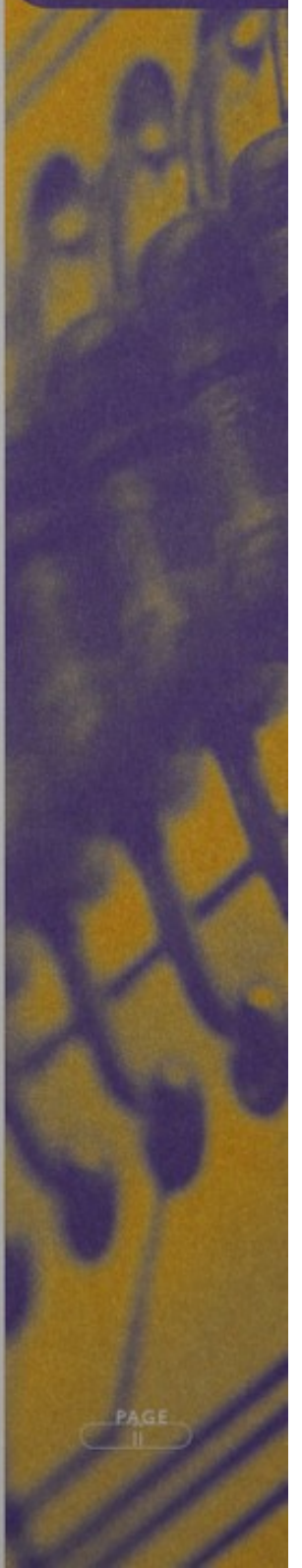
The overall breakdown of how the money was spent has changed very little since 1993/94; 50% on wages and salaries, 40% on current expenditure, and 10% on capital expenditure.

The total number of personnel full-time equivalents engaged in R&D came to 2,828 and 3,984 respectively in the business and government sectors. CRIs accounted for 92% of government R&D staff.

Excluding universities, 4,559 (67%) of R&D personnel were male and 2,253 (33%) were female. Women made up 27% of R&D staff in the business sector, 37% in CRIs, and 44% in other government departments.

Women, excluding those working in universities, accounted for 23% of researchers, 37% of technicians, and 54% of support staff. Government departments had the highest proportion of women researchers, 40%. The lowest proportion of women researchers were in business, 17%. The highest proportion of women technicians were found in CRIs, 39%, and the lowest in business, 33%. The highest proportion of women support staff were found in other government departments, whereas the lowest was in the business sector.

Since 1990/91, the technology balance of payments for business has reversed from a negative $3 million to a positive balance of $18.3 million in 1995/96. The business sector received a net amount (receipts less payments) of $19.5 million for overseas trade in technical know-how. However, for government R&D agencies, payments for technical know-how exceeded receipts, with a negative balance of $1.2 million.

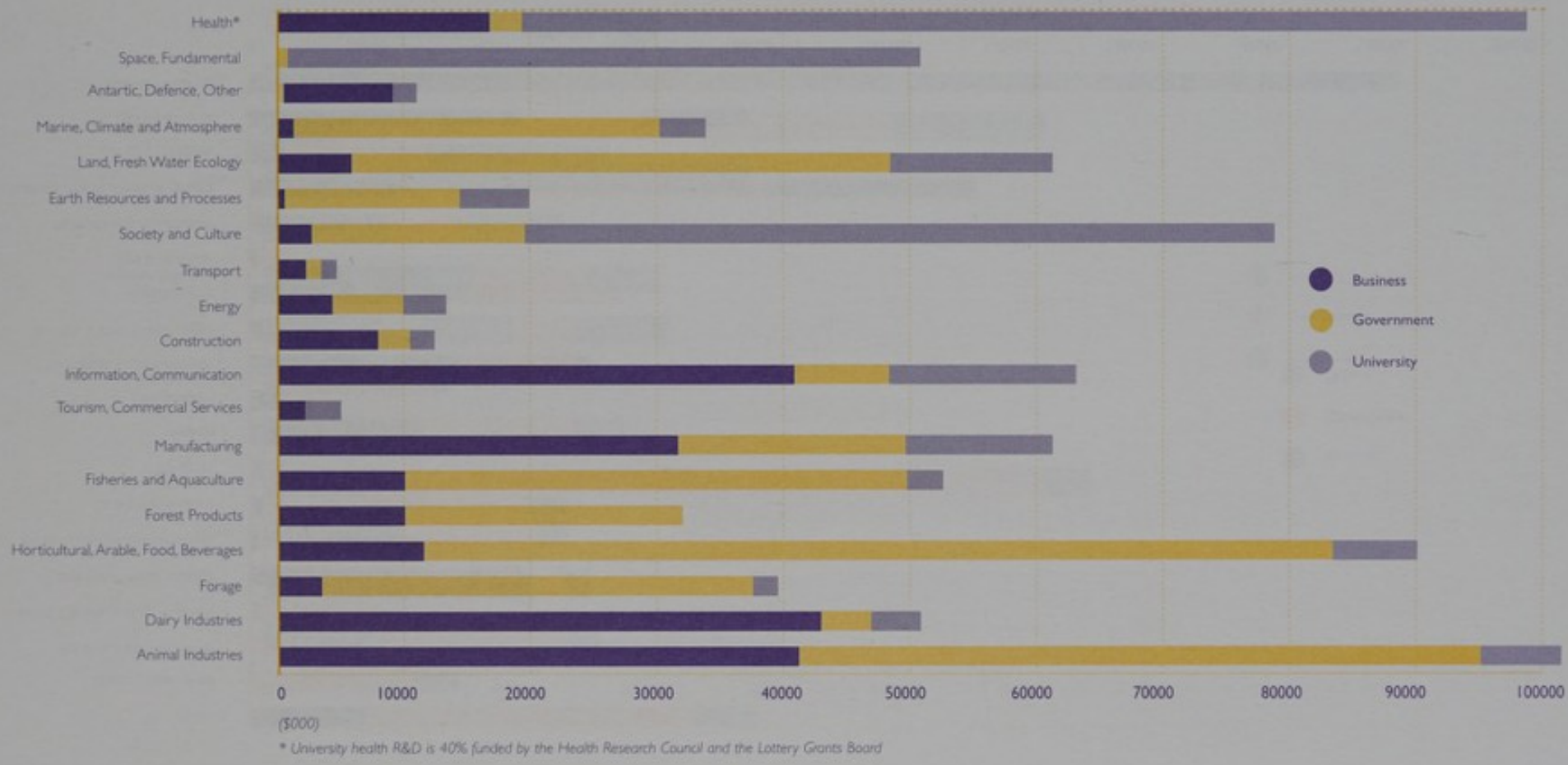


Statistical Summary, 1995

	NZ	Ref. countries average	OECD average (excl NZ)	Increase to reach average of ref. countries
1 Gross expenditures on R&D (GERD)				
- National currency $NZ million	$899			
- Equivalent $US million	$589	$2,350	$22,372	
2 New Zealand as % of other countries				
- GERD		4.2%	0.1%	
- Population		7.9%	0.4%	
- GDP		6.8%	0.3%	
3 Real annual growth in GERD (1990-95)	4.3%	3.4%	0.8%	-20.3%
4 Per capita R&D expenditure ($US)	$165	$372	$359	125.5%
5 Real annual growth per capita R&D expenditures (1990-95)	2.8%	5.2%	1.5%	85.7%
6 Real annual growth in GDP (1990-95)	4.1%	2.9%	1.4%	-29.3%
7 Per capita GDP ($US)	$16,842	$19,640	$19,608	16.6%
8 Real annual growth in per capita GDP (1990-95)	2.8%	2.3%	0.6%	-17.5%
9 GERD/GDP	0.99%	1.89%	1.80%	90.9%
- excl. defence	0.98%	1.78%	1.60%	81.6%
10 Research scientists and engineers (RSE) per 1,000	4.08	6.05	5.11	48.3%
11 GERD per RSE	$89,027	$100,787	$170,494	13.2%
12 Government and university sectors R&D performed as % of GDP	0.72%	0.73%	0.67%	1.4%
13 % of GERD funded by government	52.5%	37.8%	41.1%	-32.4%
14 Government R&D funding as a % of GDP	0.52%	0.71%	0.69%	36.5%
- excl. defence	0.51%	0.64%	0.60%	24.4%
15 Government per capita expenditure ($US) excluding general university funds				
- Agriculture	$22.01	$11.17	$7.69	-49.2%
- Industry	$12.37	$26.03	$17.29	110.4%
- Energy	$1.54	$4.30	$5.47	179.7%
- Earth exploration	$9.94	$3.64	$2.74	-63.4%
- Industrial infrastructure	$1.41	$6.81	$4.68	384.2%
- Environmental protection	$2.76	$5.24	$3.66	89.6%
- Health	$4.94	$5.74	$7.98	16.2%
- Social	$3.50	$10.25	$5.73	192.8%
16 Business sector R&D performed as % of GDP (BERD/GDP)	0.27%	1.13%	1.10%	318.5%
17 Business sector R&D funding as % of GDP	0.33%	1.03%	0.91%	212.1%

Reference countries: Australia, Denmark, Finland, Ireland, Norway, Sweden

OECD countries: Australia, Austria, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Turkey, UK, USA



* University health R&D is 40% funded by the Health Research Council and the Lottery Grants Board

Figure 1. R&D carried out by each sector in 1995/96, by the groupings used for priority setting 1995

Figure 2. R&D funded by each sector in 1995/96, by the groupings used for priority setting 1995

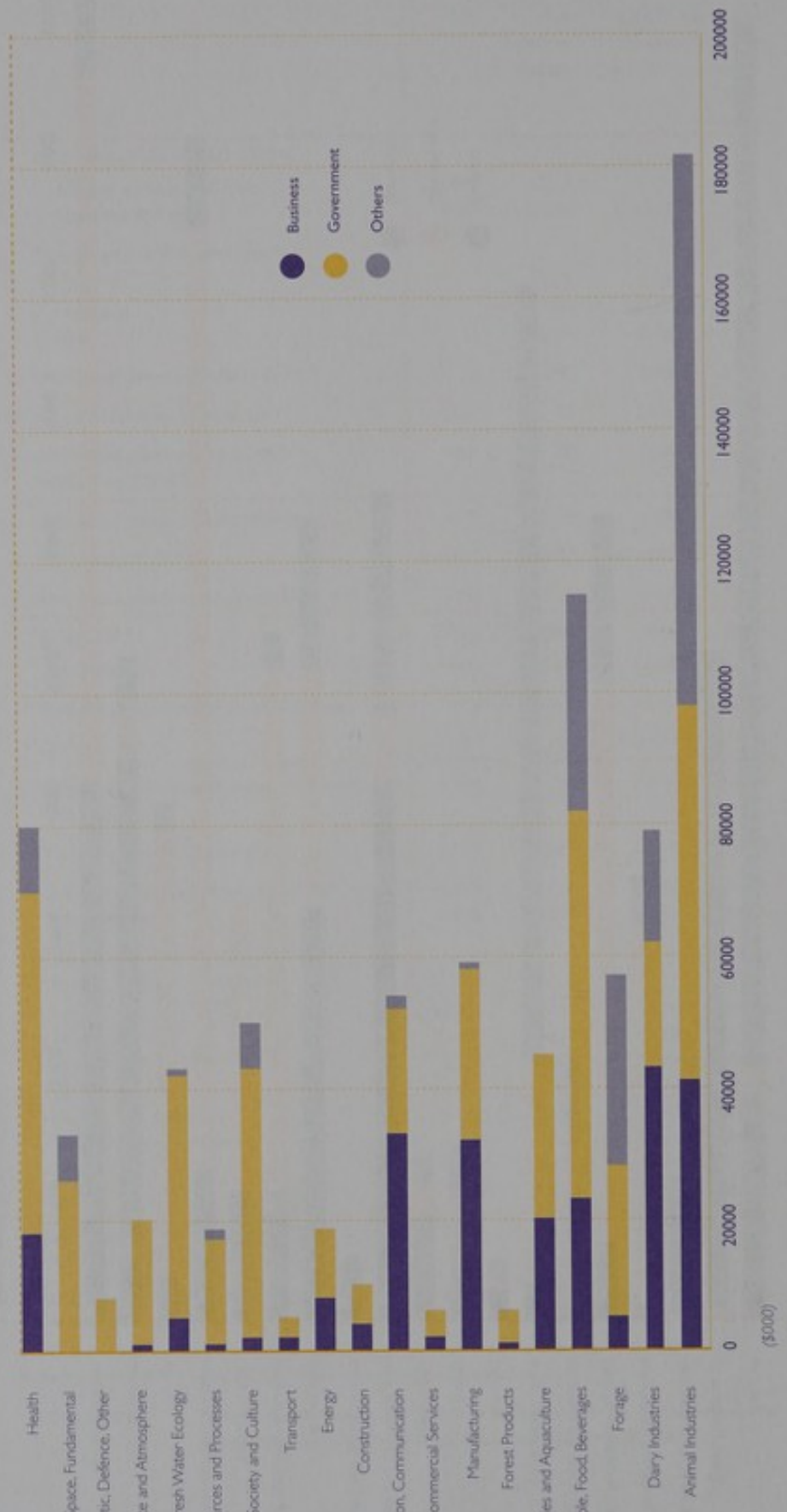
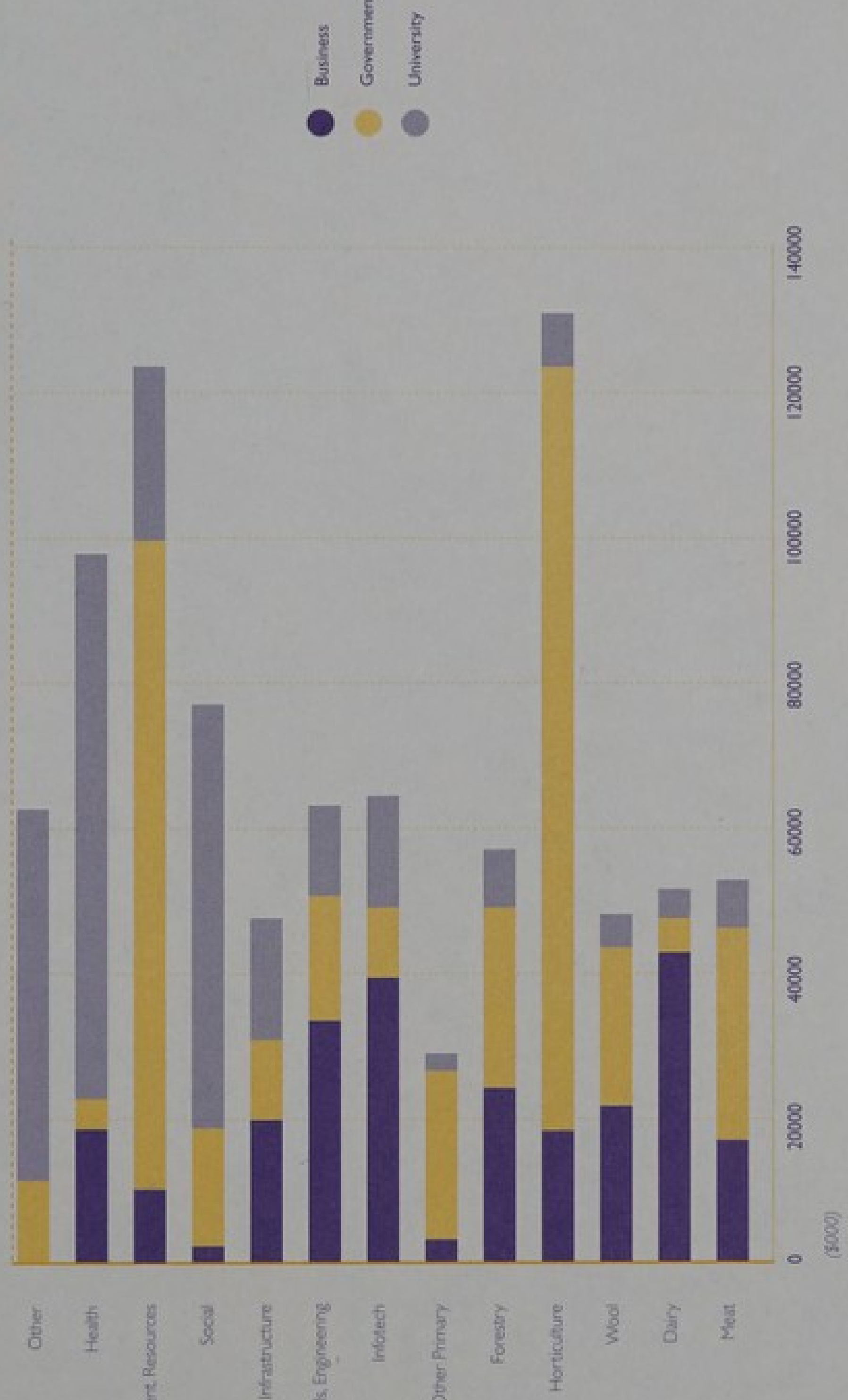
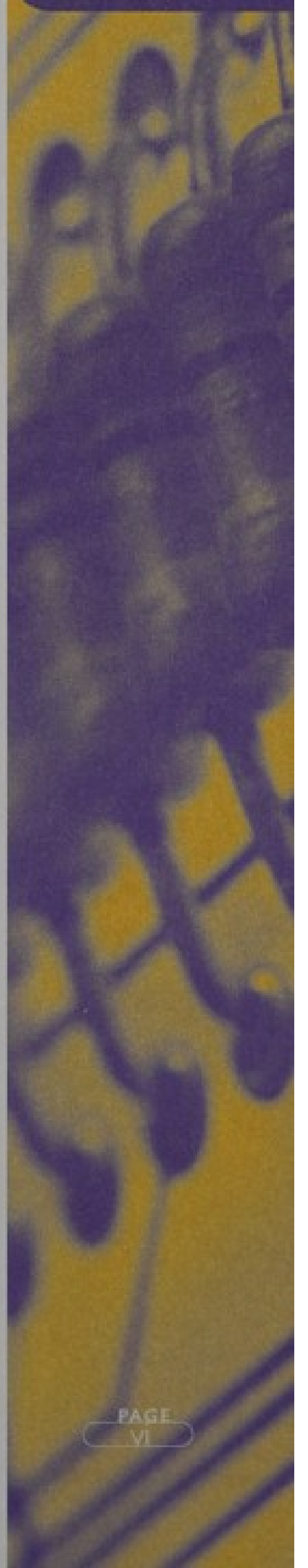
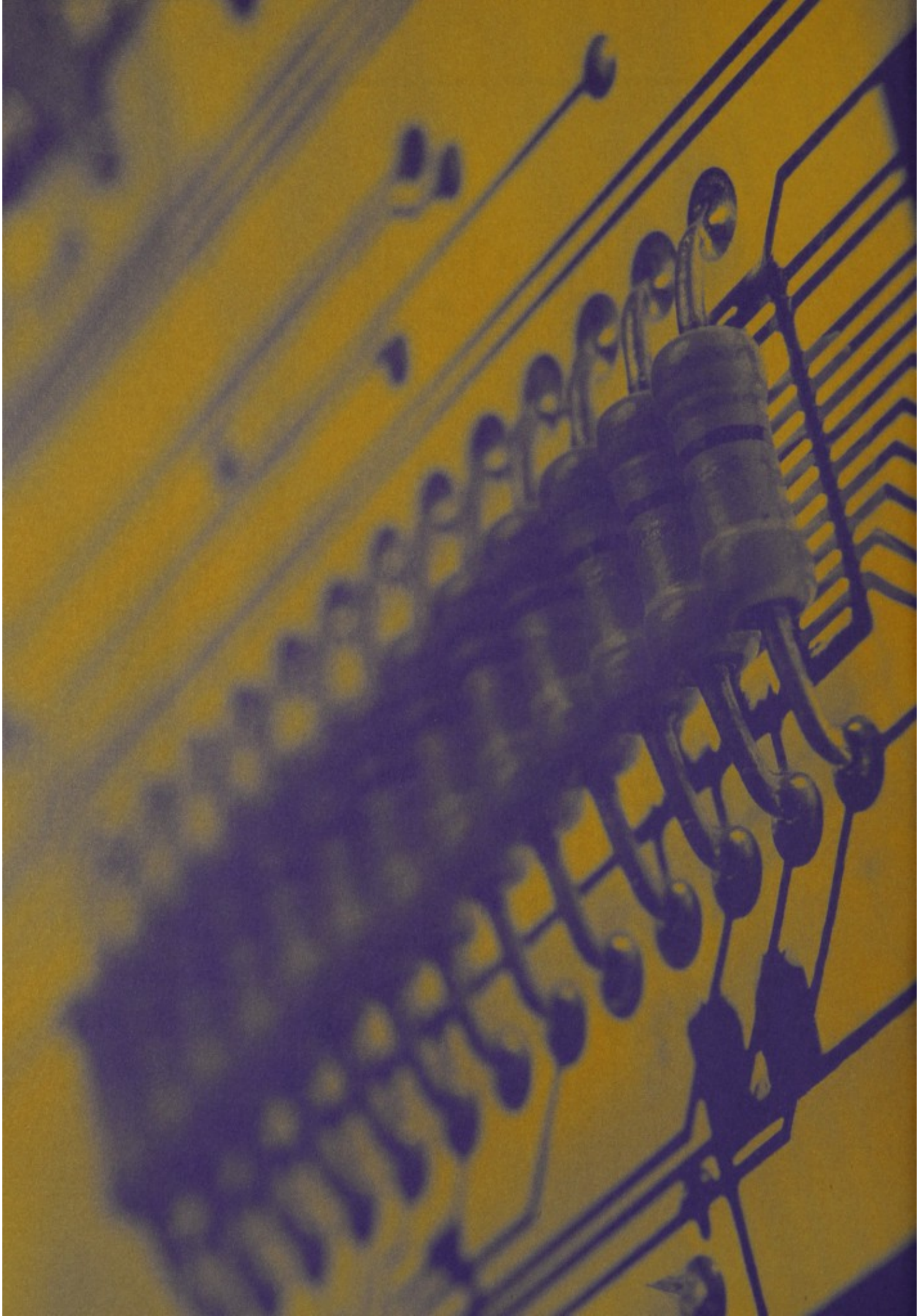


Figure 3. R&D carried out by each sector in 1995/96, by selected groupings of outputs







INTRODUCTION

A BACKGROUND

Two earlier publications[1,2], which reported on research and development (R&D) carried out in 1989/90, provided the first year of comprehensive statistical data on business and government sector R&D in New Zealand. This latest publication extends the survey to its sixth year, and includes the university sector as well as the business and government sectors. The survey of R&D performed in the business and government sectors in 1995/96 was carried out with the assistance of Statistics New Zealand. The survey of university sector R&D performed in 1996 was undertaken by the Ministry of Research, Science and Technology, with the assistance of the New Zealand Universities Vice-Chancellors' Committee (VCC).

This report is arranged in six main sections. Sections one, two and three describe the results of the survey of expenditure on R&D carried out in the three separate sectors: business, government and university. Section four combines the results from the sector-based surveys to provide total R&D expenditure in New Zealand and provide estimates of the amount of research funded, rather than performed, by each sector. Section five covers the occupations and educational qualifications of the people engaged in R&D, and section six reports on New Zealand's international trade in technical know-how.

The rest of this introduction sets the context for the R&D statistics by describing changes in the science system over the period for which comprehensive data has been collected. It also discusses methodological issues and definitions which are important for understanding the data provided in this report.

B CHANGES IN GOVERNMENT FUNDING

The past seven or eight years has been a time of considerable change in the funding of research by the New Zealand Government. The processes which had occurred up to, and including, the time of this survey (October 1996) included:

- Definition of the concept of "public-good" scientific research and of desirable science outcomes resulting from such research;
- Definition of a set of 40 science "output classes" and a grouping of these into 17 science areas, used in developing science priorities and funding levels;
- Formulation of all research within each output class in terms of research programmes with stated goals - each programme comprising defined, usually one year, research tasks or objectives;
- Reorganisation of the Department of Scientific and Industrial Research (DSIR), research branches of the Ministry of Agriculture and Fisheries (MAF) and Ministry of Forestry (MoF), and the Meteorological Service, into ten Crown Research Institutes (CRIs) which came into operation 1 July 1992; and
- Continuing encouragement of Government research organisations to undertake commercial work funded from non-Governmental sources.

New arrangements for the management of public good science were established on 1 October 1989. Science policy advice was separated from the allocation of funding and from science provision with the formation of the Ministry of Research, Science and Technology (MoRST) to

advise the Minister of Research, Science and Technology, and the Foundation for Research, Science and Technology (FRST) on the allocation of funding on a contestable basis. This replaced the direct allocation of funds by Parliament to the science departments.

The period of the first R&D survey, 1989/90, was the last year in which the Government science departments received their Crown funding through direct appropriation. The contestable bidding system commenced early in 1990. It came partially into effect during the financial year 1990/91 and fully into effect in 1991/92. The 1992/93 survey year was the first for which data was received from the CRIs.

C SURVEY METHODOLOGY

The R&D surveys are carried out according to international definitions and conform to the Frascati Manual of the Organisation for Economic Cooperation and Development (OECD) for the collection of R&D statistics. The results are used to fulfil New Zealand's international obligations to provide R&D statistics.

While remaining consistent with the requirements for international comparability, the Ministry has extended the OECD methodology in some cases to improve the relevance of the information collected to RS&T policy development. This includes asking the business sector to classify its R&D according to the Government's science output areas. This is not done in other countries, but for New Zealand this indicator is an important input into assessing the extent of partnership between government and business.

In the first year of the survey, a stratified random sample of 2,508 firms was surveyed, representing a population of 7,904 firms, research associations and producer boards, in areas of the manufacturing and service sectors which could be expected to engage in R&D. In the second to sixth years, the business sector survey population was based on the response to a brief question on R&D activity sent to the population of about 143,000 firms (all non-government enterprises earning more than $30,000 in the Statistics New Zealand Annual Business Directory Update, ABDU, survey).

The 1995/96 R&D survey is described as a 'full coverage' survey, since all firms that indicate they spent more than $5,000 carrying out or funding R&D, or buying or selling technical knowledge or information abroad, form part of the survey frame. All government departments and agencies, including local governments which carry out or fund research, are surveyed. There is also some purposive selection, where enterprises that do not fall into the above categories may have been picked up in a question in the previous survey which asked for the names of the performers of any R&D which had been funded by the respondent. Companies in the meat industry were added from a list provided by the NZ Meat Industry Association. The R&D population was finalised in September 1996. The population was 1,955 enterprises. A 90% response rate was achieved.

Questionnaires and covering information were posted to survey respondents in September 1996. Reminders for firms that had not responded were sent out in late November and telephone follow-ups commenced in December. A response rate of 100% was achieved from all government agencies and 98.5% from all business enterprises employing more than 100 full-time equivalent (FTE) staff.

There is no imputation outside the frame, given that the survey is designated full coverage. Imputation for non-respondents was carried out by a method which excluded outliers from the estimation process.

The R&D surveys aim to collect comprehensive R&D statistics from the three sectors so that they can be combined to generate a full picture of R&D. They also aim to establish a methodology for the survey process, which will then be repeated at regular intervals to obtain statistics for release to government organisations, businesses and other users in the community. The statistics are used in the development of science policy, in areas such as the setting of research priorities,

funding levels and research strategies, in science education and innovation encouragement schemes. It is hoped that the statistics will also help decision makers in making their R&D investment decisions.

D DEFINITIONS USED IN THE SURVEY

This report follows the convention used in OECD publications of standard abbreviations for the measures of R&D. Only R&D activities, as defined by the OECD, are included in the survey. Consulting and scientific and technological (S&T) services and market research are excluded.

The OECD definition of R&D is: "Research and experimental development comprises 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." Any activity classified as R&D is characterised by *originality*; it should have *investigation* as a primary objective, the outcome of which is new knowledge, with or without a specific practical application, or *new or improved* materials, products, devices, processes or services. R&D ends when work is no longer primarily investigative.

The definition of R&D, in accordance with a change in OECD standards, now includes research into, and development (or substantial modification) of, computer software, such as applications software, new programming languages and new operating systems.

A more comprehensive interpretation of the definition of R&D activity is given in the OECD publication *The Measurement of Scientific and Technical Activities* (the Frascati Manual)[6].

In line with OECD methodology, statistical information is gathered from the providers rather than the funders of research. This is in order to prevent the same research being reported twice, by both the provider and the funder. Providers are also usually in the best position to determine whether work is R&D or S&T services, and to report on the resources actually expended on research. Information on the sources of funds used by providers is then used to estimate the funding of R&D by each sector.

Most of the tables in this report represent expenditure on R&D *carried out* in each of the three sectors: business enterprise R&D (BERD), government R&D (GOVERD), and higher education R&D (HERD). That part of university funds for research which comes from Vote Education and is part of the employment contract of academic staff is called "general university funds" or "GUF", as distinct from income from student fees and other sources, including research monies allocated by independent funding bodies, such as the Foundation for Research, Science and Technology or the Health Research Council.

Intramural R&D statistics presented in this publication refer to R&D activity *carried out* by an organisation on its own behalf or on behalf of other organisations or individuals. *Extramural* R&D statistics refer to R&D *funded* by an organisation but *carried out* by others.

Total *funding* of R&D by each sector is estimated by subtracting from intramural R&D for that sector the part which is funded from outside the sector and adding any R&D which that sector funds in any other sector.

R&D *expenditure* includes: *capital* expenditure on the acquisition of fixed, tangible assets such as land, buildings, vehicles, plant, machinery and equipment attributable to R&D activity; *current* expenditure on wages, salaries and other labour costs, materials, repair, travel, etc., attributable to R&D; and the proportion of expenditure on general services and overheads which is attributable to R&D activity.

Human resources devoted to R&D measure the effort of researchers, technicians and other staff *directly* involved with R&D activity. Overhead staff (e.g. administrative and general services employees, such as personnel officers and cleaners) whose work *indirectly* supports R&D activity, are excluded from counts of personnel but their costs are included in overheads.

Researchers are those involved with the conception and/or development of new products or processes. They include project managers, directors, scientists and engineers concerned with project content but exclude those concerned with administrative matters.

Technicians are those performing technical tasks in support of R&D activity, normally under the direction and supervision of a researcher. These tasks include performing experiments, maintaining and operating advanced equipment, and computer programming.

Other supporting staff are those skilled and unskilled craftspersons, and secretarial, administrative and clerical staff, directly associated with R&D activity.

Technological balance of payments is the collation of those invisible international transactions relating to trade in technical knowledge or know-how. *Technical know-how* is defined as: existing specialised technical knowledge that is required to produce a successful product or implement a process, e.g. patents, licenses, technical data and information, and scientific, technical or engineering assistance that increases technical knowledge and understanding in the organisation.

Payments for technical know-how exclude other costs, such as overseas travel and subscriptions to periodicals, as well as the cost of computer software and scientific, technical or engineering services that are not aimed at increasing the technical knowledge of the organisation.

Receipts for technical know-how exclude contract or commission work carried out on behalf of others.

The *business enterprise* sector includes all enterprises 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 cost of production, and the private non-profit institutions mainly serving them.

The organisational unit for the collection of R&D statistics is the enterprise. An *enterprise* is defined broadly as the unit comprising all the operations in New Zealand of a single operating legal entity (e.g. company, partnership or sole proprietor).

The vast majority of enterprises included are private businesses. The remainder are public business enterprises mainly engaged in trading or financial activities, research associations funded by levy or grant, producer boards, private non-profit organisations and local authorities.

The survey population covers a wide range of industries from the *New Zealand Standard Industrial Classification* (NZSIC) 11214 *Landscape Planting and Maintenance Services* to 95991 *Funeral Directors*, and between all divisions from *Forestry and Logging* to *Personal and Household Services*. The survey covered industries from a total population of 171,676** government and private sector enterprises (virtually the entire economy, excluding farming enterprises).

Farming enterprises (i.e. industries in major group 111 of NZSIC, 1987 edition) were not included in the Statistics NZ Business Directory update, so were not canvassed for inclusion in the survey. Farming companies known to be doing R&D were included. Agricultural R&D activity is generally carried out by specialised research associations.

For the purposes of R&D statistics, the OECD recommends that research institutes be classified according to the industry they predominantly serve, and this recommendation has been followed in this report. The predominant output area specified by each research association was used as a guide, and supplementary NZSIC codes assigned and used in all tables for the data provided by the research institute.

Each enterprise is classified to the industry in which it mainly operates even though one or more of its component activity units (factories, shops, etc.) may be classified to other industries. For further comment see the *New Zealand Standard Industrial Classification*, 1987 Edition[8].

** *This population is taken as at February 1994 from "Business Activity 1995", Statistics NZ*

E OECD REFERENCE COUNTRIES

Six countries from within the OECD have been identified by the New Zealand Institute of Economic Research (NZIER, also see Edwards, 1992") as having a number of similar characteristics to New Zealand regarding population, size of the economy, and stage of economic development. These countries, Australia, Denmark, Finland, Ireland, Sweden and Norway, are used in this report as a basis for international comparison of some of the main results and are referred to as the OECD "reference countries".

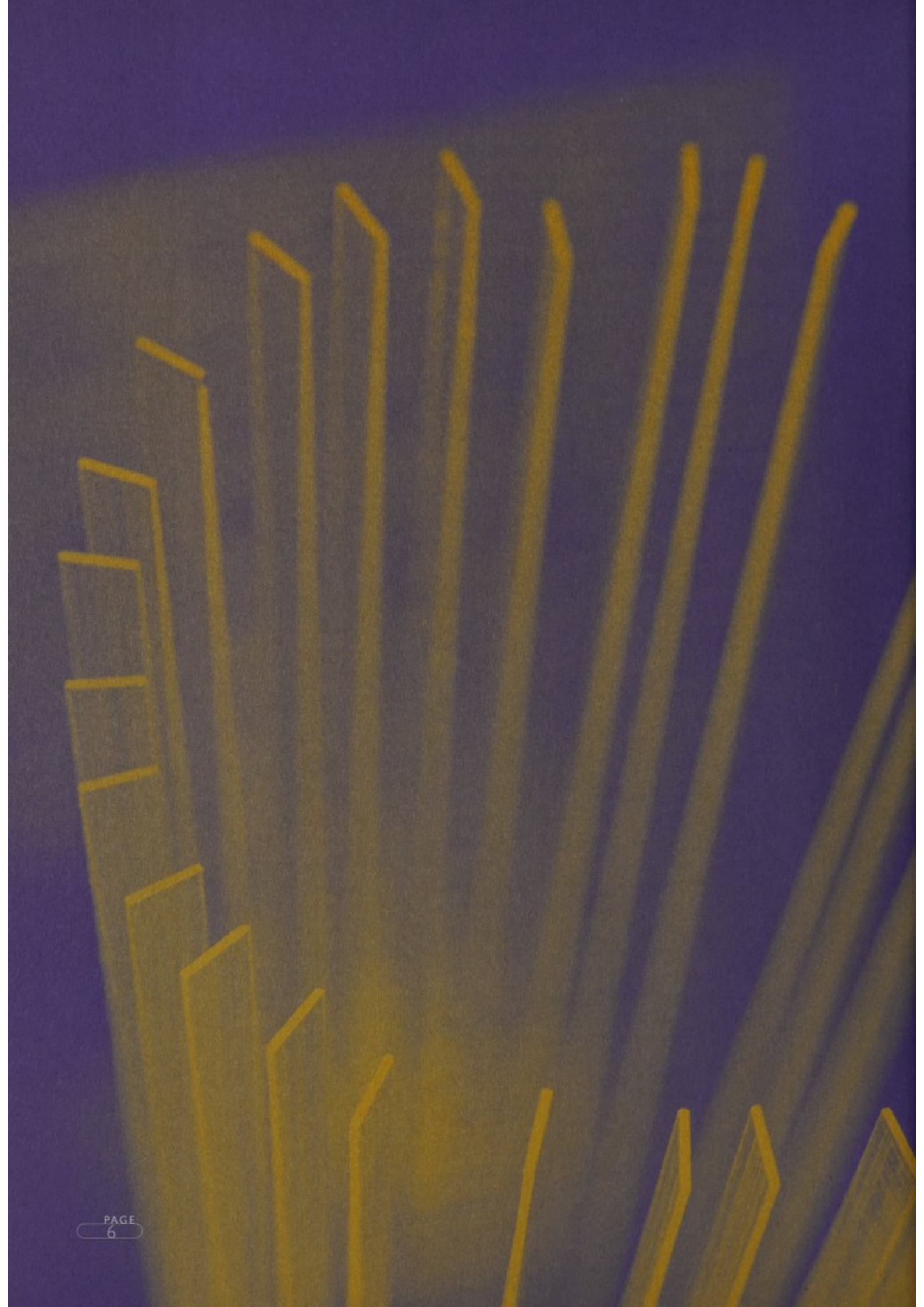
F LIMITATIONS OF THE SURVEY DATA

There are limitations to the level of accuracy that can be expected from an R&D survey. Many respondents do not keep separate account of their R&D expenditure, or they may include R&D with other scientific and technological services, such as consulting. Records may not be kept in the form required for the survey and considerable estimation may be required. Detailed descriptions of what should and should not be included as R&D were provided on the questionnaire form, and phone-in help was available and utilised. However, best estimates were required in many cases. As the survey is repeated, the results can be expected to become more reliable as respondents become more experienced.

The OECD requirement for international comparability means that capital expenditures were requested rather than depreciation. This is in order to avoid comparison of different systems of depreciation internationally. It needs to be borne in mind that large capital expenditures can cause fluctuations in total expenditure from year to year and this can mask a trend or introduce a false trend.

The 1989/90 business enterprise survey was based on a stratified sample; all subsequent surveys except the fourth have had full coverage. The fourth survey (1992/93) included only top providers and funders for the business enterprise sector, plus rated-up estimates for the rest. The government sector was full coverage. Sampling error will no doubt contribute to the fluctuations noted between the 1992/93 survey and the full coverage surveys, and this must be taken into account when making comparisons. The 1993/94 and 1995/96 surveys were based on full coverage. There was no survey of R&D carried out in 1994/95.

Firms are now becoming experienced in responding to the R&D survey and it is expected that consistency of reporting will continue to improve. In the future, improved consistency may mean that data from earlier surveys needs adjusting if long-term trends are to be extrapolated.



1 BUSINESS

1.1 KEY RESULTS

- R&D carried out by the business sector decreased by $7.6 million, or 3.1% in 1995/96. This is the first decrease since 1990/91, and it was mainly due to a number of one-off projects occurring in information and communications in the previous year. The amount of R&D business enterprises carried out with business sector funding decreased by $13 million***, or 6.1% while the R&D funding that the business sector reported coming from other sectors increased by $5.9 million.
- Expenditures on R&D carried out by the business sector amounted to $240.3 million in 1995/96 (down from $247.9 in 1993/94). This was equivalent to 0.27% of GDP (down from 0.31% in 1993/94). The average for the six OECD reference countries (see section E of the Introduction) was 1.13% (1.21% in 1993/94), more than four times the level in New Zealand.
- There were 660 enterprises in New Zealand undertaking R&D, as defined in the Frascati Manual. This is one out of every 216 enterprises in New Zealand. A further 68 enterprises were either funding R&D or trading technical know-how abroad. Other businesses may undertake less formal or on-the-job research which was not classified as R&D or could not be identified. However, the New Zealand survey includes enterprises with less than 10 employees, which most overseas surveys do not, and about 9.2% of the total reported R&D was from these small firms.
- Research directed towards primary production and processing increased by 11.8%. Within this group, arable crop, dairy research and fibre & skin processing experienced higher rates of growth, 82.3%, 81.4% and 78.4% respectively. In 1995/96, climate research showed the largest increase, but from a very small base. Environmental protection research rose a further 68.7% after a big increase in 1993/94.
- In information technology related area, computing and electronic research increased by 43.8% while information and communications research declined by 57.4%. Together these industries showed a decrease of 30%.

1.2 OUTLINE OF THIS SECTION

After a brief introduction, which discusses some characteristics of the survey responses, the rest of this section is divided into four parts. The first part, section 1.4, starts with a description of changes in the pattern of R&D expenditure by the major groups of science outputs, or areas of research, since 1991/92. This is followed by more detailed comparison of R&D expenditure for the two most recent surveys.

Section 1.5, shows business sector R&D by industry group, looking at the type of funds (salaries, current and capital), the number of responding firms, and R&D personnel full-time equivalents (FTEs) by industry.

Section 1.6, provides an analysis of the source of funds for R&D carried out in the business sector, and of research carried out in other sectors with business funding, by industry group. Three different methods of estimating total business enterprise research funding are described.

*** *Based on source of funds information from respondents (see sections 2 and 3 below).*

1.3 BUSINESS SECTOR: INTRODUCTION

The R&D questionnaires were sent to 1,955 enterprises. These enterprises indicated in the Statistics NZ Annual Business Directory Update (ABDU) survey which was sent out in February 1996 that they spent more than $5,000 carrying out or funding R&D, or buying or selling technical know-how abroad. The response rate to the R&D survey was 90.26%, with a 98.53% response rate from business enterprises with more than 100 FTE employees.

Based on the stricter Frascati definition of R&D used in the R&D survey, 740 enterprises (0.52% of the survey population) stated that they provided or funded R&D or traded in technical know-how. R&D was being carried out by 660 respondents, while 235 were funders, some of whom also carried out their own research. Sixty nine respondents purchased technical know-how abroad, and 51 received income from the overseas sale of technical know-how. The number of enterprises performing or funding R&D, or trading abroad in technical know-how, has declined compared with previous surveys.

	Carrying out R&D	Funding R&D
1990/91	736	265
1991/92	765	286
1992/93	n/a	n/a
1993/94	661	234
1994/95	n/a	n/a
1995/96	660	235

Total R&D carried out in the business sector: total R&D carried out in the business sector was $240 million, down $8 million from $248 million in 1993/94. Business enterprises include industry research associations and producer boards which carried out $63 million of the business sector R&D in 1995/96 ($59 million in 1993/94).

Total R&D funded by the business sector: the business sector funded between $240 and $299 million R&D in 1995/96, depending on the method of estimating funding, plus $11 million which was spent overseas. The amounts the business sector reported as being spent on research in other sectors (giving the lower figure) did not match the funds that respondents in other sectors said they receive from the business sector (giving the higher figure). There is no easy reconciliation between these two estimates, although a variety of possible explanations could be offered. The lower amount is used in this chapter to match with the responses from the business sector. However, in keeping with the OECD methodology of using provider figures, the higher amount is used as the "official" data in Chapter 4, where data from each of the separate sector surveys is combined.

The distribution of the R&D expenditure of the business sector was heavily concentrated in a small number of firms. Of the total of $251 million spent on research which was funded by the business sector (but not necessarily carried out in the sector), $64 million was funded by research associations and producer boards. The remaining $187 million was spent as follows:

The top 5 firms spent $34 million, or 18%.

The top 10 firms spent $49 million, or 26%.

The top 70 firms spent $121 million, or 65%.

Each enterprise in the survey was asked to state the output class which best described the purpose of its R&D. This is not a common practice amongst OECD countries who normally use this output, or purpose-based, classification only for government sector research. It is used in New Zealand in order to be able to compare private sector R&D with government (and university) R&D in a way that is relevant to the Government's priority setting for public investment in R&D. Output classes are New Zealand Government science funding categories, used in setting priorities and making funding allocation decisions for public good research, either individually or grouped.

Therefore, in addition to classifying R&D by the industry group (NZSIC) to which the enterprise belongs, business sector R&D in New Zealand can also be grouped by science output class. It is recognised that in some instances, firms may confuse the purpose with the nature of the R&D, e.g. R&D developing agricultural machinery may be coded to Output Class 17 (engineering process, systems and products), instead of to the appropriate agricultural output class. However, this is not considered to be a significant problem.

Forty statistical output classes have been used for collecting data since 1989/90. Fifteen science areas were used to develop science strategies in 1992/93. A priority setting exercise in 1995 used a different grouping of 17 output areas. These 17 groupings, with the addition of categories for health research and for space and fundamental research, are illustrated in Figures 1 and 2 on pages iv and v of the Executive Summary.

Descriptive detail of the 40 science output classes is given in Annex 3.

1.4 BUSINESS ENTERPRISE R&D (BERD) CARRIED OUT IN EACH SCIENCE OUTPUT CLASS

1.4.1 Overview of changes over time by science output class

The total expenditure on R&D carried out by the business enterprise sector decreased between 1993/94 and 1995/96 by $7.57 million, to $240.3 million. This overview describes changes in R&D by the seven subgroups of the 40 output classes. These sub-groups distinguish between R&D for primary production, primary product processing, other manufacturing, infrastructure, social sciences, environment and other research. (Summaries of R&D according to the 40 science output areas and these seven subgroups for the business sector are given in Table 17 (business and government R&D) and Table 24 (business, government and university R&D)).

In total, primary production and primary product processing (outputs 1 to 15) have shown a consistent increase in business R&D expenditure since 1991/92. The R&D expenditure in these groups is $121.7 million, $108.9 million, $96.5 million and $85.1 million respectively in each of 1995/96, 1994/93, 1992/93 and 1991/92. But its proportion of total intramural business R&D varied. It represented 50.7% of intramural business enterprise R&D in 1995/96, 44% in 1993/94, 47% in 1992/93 and 44% in 1991/92.

Over 23% of the R&D is aimed at outputs 16 to 18, the development of new and improved materials and industrial processes, engineering products and processes, and computing, electronic, telecommunication and instrumentation processes, systems and products. R&D reported in this group increased by $1.3 million to $55.7 million in 1995/96 after a similar increase in 1993/94.

About 15% of the research is aimed at outputs 19 to 24, the development of improved infrastructure and services. These include: construction, commercial and trade services, energy, transport, information and communication services, and urban and rural planning. R&D in these areas showed a big decrease between 1993/4 and 1995/96, of 41%. The main reason is that R&D reported by the major performers in these areas in 1993/94 was for one off projects.

Table 1. R&D carried out in the business sector by strategic science area

	Strategic Science Areas		1995/96	1993/94	1992/93
Output classes	Output Aggregation	No. of firms	R&D Expenditure ($000)		
1, 2, 11, 14	Sheep and beef production, meat, fibre, textile and skin processing	108	40,057	32,059	31,064
3, 12	Dairy production and processing	55	43,083	42,212	37,978
4	Alternative animal species	11	563	613	225
5	Generic animal research	6	1,542	1,639	637
6	Forage plants	18	4,583	2,836	2,553
7, 8, 13	Horticulture, arable and other plant production, and processing	108	15,022	16,751	14,253
9, 15	Plantation forestry production and processing	55	15,158	11,885	9,554
10, 32	Fisheries, and marine & fresh water	29	2,640	2,149	1,007
16, 17, 18, 19	Materials, industrial processing, engineering, electronics, instruments and construction	272	64,305	62,691	58,527
20, 21, 22, 23, 24	Infrastructure, including commercial and trade services, energy, transport, information & communication, and urban & rural planning	162	28,752	54,859	33,222
25, 26, 27, 28	Social sciences, including history, culture, relationships, politics and economics, and education & training	50	2,760	3,317	3,249
29, 30, 31, 33	Protection, exploration and assessment of the earth (excluding marine and fresh waters)	36	5,784	4,178	1,784
35	Antarctica	4	n.p.	n.p.	n.p.
34, 36	Space and fundamental knowledge	3	1	218	113
37	Health	42	15,958	12,033	10,545
38, 39	Others	5	n.p.	n.p.	n.p.
	Total	660*	240,319	247,890	204,839

* Total number of firms has been adjusted for non-response rate.

Industry totals have not been adjusted, and will not sum to the TOTALS.

n.p. = not for publication to protect confidentiality of responses.

In 1995/96, business enterprises targeted $16 million (6.6% of their total R&D) at health research, increasing $4 million from 1993/94. Research aimed at the protection of the environment (which includes pollution and waste management), research into natural resources and research into fundamental knowledge increased by $1.1 million in total from 1993/94 to 1995/96. These comprised 2.8% of intramural business R&D in 1995/96 compared with 2% in 1993/94 and 1% in 1992/93. Reported research on social development, including economic research, showed a small decrease, coming after a small increase in 1993/94.

The following sub-sections discuss the changes in R&D according to fifteen sector-based groupings used in the 1992/93 priority setting process. These groups combine the science output areas for production and processing for each sector and are useful for comparing expenditure levels between each vertically integrated sector. Summary totals for these 15 strategic science areas are shown in Table 1. (Note: this is not the same as the amount funded by the private sector in each output category which is shown in Table 16.)

1.4.2 *Sheep and beef production, meat, fibre, textile and skin processing*

Business R&D expenditures in this group are highly concentrated in fibre, textile & skin processing and meat processing, which represent 59% and 36% of total R&D in this group respectively. The overall R&D expenditures in this group increased by almost $8 million, to $40.1 million in 1995/96. The biggest increase was in fibre, textile & skin processing, which increased from $13.2 million in 1993/94 to $23.5 million in 1995/96.

Table 2. R&D carried out in outputs 1, 2, 11, 14

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
1. General Sheep Production	1,587	4	-23	2,055	6	-43
2. Beef Production	721	2	-38	1,166	4	416
11. Meat Processing	14,242	36	-9	15,662	49	13
14. Fibre, Textile & Skin Processing	23,508	59	78	13,176	41	-1
Total	40,057	100	25	32,059	100	3

R&D in beef production decreased dramatically between 1993/94 and 1995/96 after a big increase in1993/94. R&D on general sheep production has decreased since 1993/94.

1.4.3 *Dairy production and processing*

R&D expenditure on dairy production and processing slightly increased by $0.87 million, reaching $43 million in 1995/96. Dairy production has experienced considerable growth in its R&D expenditure, rising to $5.8 million in 1995/96 while dairy processing dropped $1.7 million. Business sector R&D in dairy processing has traditionally been much higher than in dairy production.

Table 3. R&D carried out in outputs 3, 12

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
3. Dairy Production	5,780	13	81	3,187	8	43
12. Dairy Processing	37,303	87	-4	39,025	92	9
Total	43,083	100	2	42,212	100	11

1.4.4 *Alternative animal species, generic animal research and forage plants*

Business R&D expenditure in both alternative animal species and generic animal research experienced a small drop in 1995/96, after a big increase in 1993/94. R&D in forage plants increased steadily over the period, with spending of $4.6 million on R&D in 1995/96.

Table 4. R&D carried out in outputs 4, 5, 6

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
4. Alternative animal species	563	8	-8	613	12	173
5. Generic animal research	1,542	23	-6	1,639	32	157
6. Forage plants	4,583	69	62	2,836	56	11
Total	6,688	100	31	5088	100	49

1.4.5 Horticulture, arable and other plant production, and processing

R&D expenditure in this group was down $1.7 million to $15 million in 1995/96, from $16.7 million in 1993/94. Of this total, other food processing accounted for 52%, horticulture for 25%, and arable for 23%. Spending in other food processing (output class 13) decreased by 39%, while horticulture, arable and other plants increased by 79% and 82% respectively.

Table 5. R&D carried out in outputs 7, 8, 13

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
7. Horticulture	3,817	25	79	2,133	13	-26
8. Arable & other plants	3,466	23	82	1,901	11	-4
13. Other food processing	7,739	52	-39	12,718	76	35
Total	15,022	100	-10	16,751	100	18

1.4.6 Plantation forestry production and processing

Total R&D expenditures in this group rose 27.5% in 1995/96, following a 24.4% increase in 1993/94. The increase in plantation forestry production was 29% compared with 26% in wood and paper processing. R&D in this group has been increased consistently since 1991/92.

Table 6. R&D carried out in outputs 9, 15

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
9. Plantation forestry	8,319	55	29	6,437	54	37
15. Wood & paper processing	6,839	45	26	5,448	46	12
Total	15,158	100	28	11,885	100	24

1.4.7 Fisheries, and marine and fresh waters

R&D expenditures in this group increased by $0.49 million to $2.6 million in 1995/96. Of the total, fisheries contributed $1.7 million, accounting for 65%. R&D expenditure in the fisheries industry has shown a strong increase following a big jump in 1993/94 whilst the marine and fresh water area experienced a small decrease in 1995/96 after an increase in 1993/94.

Table 7. R&D carried out in outputs 10, 32

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
10. Fisheries	1,712	65	88	910	42	282
32. Marine & fresh waters	928	35	-25	1,239	58	61
Total	2,640	100	23	2,149	100	113

1.4.8 Materials, industrial processing, engineering, electronics, instruments and construction

R&D expenditure in this group has been increasing since 1991/92, with a further $1.6 million increase in 1995/96. Of the $64.3 million spent by this group, $22.7 million goes on research aimed at new and improved computing and electronic, communication and instrumentation processes, systems and products (output class 18). This is $6.9 million more than was reported in 1993/94. However, the wording of output classes 18 and 23 (which showed a large decrease in R&D in 1995/96) both relate to R&D in information processing and communications. It is sometimes difficult to be sure that a change in amount of R&D reported in these areas is due to classification difficulties or to a real change. Because software services apply to many different industries, a particular piece of software research may also be classified with the industry area it serves.

New and improved materials, industrial processes and products from chemicals, petroleum and coal, base metals and glass, including plastics, rubber and pharmaceutical (output class 16) accounted for R&D of $6.6 million in 1995/96, a decrease of $5.1 million. Engineering processes, systems and products, including manufacturing, automation and production technologies for fabricated metal products, transport equipment, agricultural machinery and mechanisation, appliance and electrical equipment, and industrial and construction machinery and equipment (output class 17) is still the largest output in this group, and amounts to $26.4 million, a slight decrease from 1993/94.

Table 8. R&D carried out in outputs 16 to 19

Output classes	R&D expenditure					
	1995/96			1993/94		
	$000	% of total	% change on previous year	$000	% of total	% change on previous year
16. Materials & industrial processing	6,621	10	-44	11,761	19	21
17. Engineering	26,370	41	-2	26,902	43	5
18. Electronics & instruments	22,673	35	44	15,762	25	-9
19. Construction	8,641	13	5	8,266	13	42
Total	64,305	100	3	62,691	100	7

1.4.9 Infrastructure

There has been a dramatic decrease in R&D expenditure in this grouping in 1995/96. This grouping includes R&D in commercial and trade services which includes tourism ($2.7 million), energy ($4.8 million), transport ($2.9 million), information and communication ($18 million) and urban and rural planning ($0.34 million).

About $18 million of R&D in this group was spent on output class 23, new and improved information and communication services, including computer software, information processing,

library and related information services, broadcasting, telecommunications, postal and other communications services. There was a big decrease in intramural R&D expenditure for this output class of $24 million. This is because the major performers in this output class reported that their R&D in 1993/94 was for one off projects. When this output is combined with output 18, which represents electronics, including communications hardware, it is clear that information systems comprise a large area of business enterprise sector R&D in New Zealand. The two outputs total $40.6 million in 1995/96 ($57.9 million in 1993/94), or 17% of all the business enterprise R&D.

Table 9. R&D carried out in outputs 20 to 24

Output classes	*R&D expenditure*					
	1995/96			*1993/94*		
	$000	*% of total*	*% change on previous year*	*$000*	*% of total*	*% change on previous year*
20. Commercial & trade services	*2,707*	*9*	*-44*	*4,848*	*9*	*60*
21. Energy	*4,796*	*17*	*2*	*4,685*	*8*	*183*
22. Transport	*2,906*	*10*	*-4*	*3,030*	*5*	*34*
23. Information and communication services	*17,963*	*62*	*-57*	*42,144*	*77*	*61*
24. Urban & rural planning	*380*	*1*	*149*	*153*	*0.3*	*5*
Total	*28,752*	*100*	*-48*	*54,859*	*100*	*65*

1.4.10 Social sciences, the environment, and natural resources

Social sciences, the environment and natural resources do not receive much attention from the business enterprise sector. Overall, the social sciences funding on R&D decreased by $0.56 million in 1995/96 after a slight increase in 1993/94 ($2.8 million in 1995/96, $3.3 million in 1993/94 and $3.2 million in 1992/93). Specifically, R&D on the areas of politics and the economy, social relationships and well-being and history, society & culture decreased 17%, 5% and 35% respectively. R&D on protection, exploration and assessment of the earth has increased by $1.6 million to $5.8 million in 1995/96.

Table 10. R&D carried out in outputs 25 to 33, excluding 32

Output classes	*R&D expenditure*					
	1995/96			*1993/94*		
	$000	*% of total*	*% change on previous year*	*$000*	*% of total*	*% change on previous year*
25. History, society & culture	*212*	*2*	*-35*	*326*	*4*	*39*
26. Relationship & wellbeing	*624*	*7*	*-5*	*655*	*9*	*128*
27. Political & economic training	*1,526*	*18*	*-17*	*1,841*	*25*	*-29*
28. Education, knowledge & training	*396*	*5*	*-20*	*494*	*7*	*275*
29. Environmental protection	*4,441*	*52*	*68*	*2,638*	*35*	*103*
30. Geological structure	*627*	*7*	*-17*	*759*	*10*	*94*
31. Land based flora & fauna	*174*	*2*	*-74*	*682*	*9*	*930*
33. Climate & atmosphere	*541*	*6*	*447*	*99*	*1*	*249*
Total	*8,544*	*100*	*14*	*7,494*	*100*	*49*

Business sector R&D in space (output 34) and Antarctica (output 35) are too insignificant to be published separately.

1.4.11 Fundamental knowledge, health and defence

Expenditure on R&D in health (output 37) increased a further 32.6% to $16 million in 1995/96, after increasing 14% in 1993/94. R&D on health has been increasing since 1991/92. Business sector R&D in fundamental knowledge (output 36) and defence (output 38) are too insignificant to be published separately.

1.5 R&D BY INDUSTRY GROUP

1.5.1 Intramural business sector R&D, by industry group

The previous section gave the allocation of R&D by science output class. This section analyses the results according to the industry to which the enterprises undertaking R&D belong using the New Zealand Standard Industrial Classification (NZSIC). To protect confidentiality while providing the maximum amount of additional information, enterprises are grouped into 34 industry groups which is consistent with the industrial classification proposed by the OECD. These are given in Table 11.

In this analysis, and throughout this report, the research associations are classified to the industry group they predominantly serve. As the Statistics NZ Business Directory is updated annually, an enterprise may be reclassified to a new NZSIC if its predominant activity has changed.

Overall R&D expenditure showed a decrease in 1995/96, down 3.1%. However, within industry groups, major differences were seen. Of the 34 industry groups, thirteen showed increased expenditure:

- The largest percentage increase occurred in the wearing, apparel & fur, textiles, wood products, pulp & paper and non-profit organisations which increased 157.5% ($0.37 million), 106.1% ($11.4 million), 89.7% ($3.3 million) and 88.6% ($5.9 million) respectively;
- The next largest percentage increase came from motor vehicles, ships and aerospace, other manufacturing (nec) and computer services, increasing 57.3%, 51.8% and 44.6%;
- Agriculture, forestry and fishing, and electrical equipment increased by 38.4% and 35.8% respectively; and
- Other increases occurred in furniture, chemical products, electrical machinery and in producer boards and research associations

Several categories showed reduced R&D expenditure:

- The largest area of expenditure is in food, textiles and plastics, which decreased by $5.3 million (24%); and
- Other areas which experienced a big decrease in R&D were transport & storage, financial intermediation, and fabricated metal products.

Table 11. R&D carried out by industry sector

NZSIC	Industry groups	No. of firms	1995/96 R&D Expenditure ($000)	1993/94 R&D Expenditure ($000)	1992/93 R&D Expenditure ($000)
1000	Agriculture, forestry & fishing	38	12,628	9,126	6,917
2000	Mining	5	681	1,188	n.p.
3100	Food products and beverages	55	59,710	65,021	54,634
3140	Tobacco products	0	0	0	0
3210	Textiles	12	22,050	10,689	11,279
3220	Wearing, apparel & fur	6	605	235	275
3231	Leather products & footwear	7	2,558	3,040	2,270
3310, 3410, 3420	Wood products, pulp & paper	14	7,001	3,691	2,967
3510	Chemical products less pharmaceuticals	26	9,127	7,025	8,042
3522	Pharmaceuticals	7	3,190	3,410	2,917
3550	Rubber & plastic products	21	3,722	4,952	5,865
3600	Non-metallic mineral products	8	2,336	3,680	2,095
3710	Basic metals, ferrous	4	1,063	n.p.	1,145
3720	Basic metals, non- ferrous	6	576	n.p.	n.p.
3810	Fabricated metal products	23	3,488	6,592	5,105
3820	Machinery, nec	42	7,416	10,435	8,455
3825	Office & computing equipment	5	n.p.	248	191
3830	Electrical machinery	25	22,012	21,501	19,006
3832	Electrical equipment, radio, TV	21	14,135	10,409	8,670
3850	Medical, precision, & optical instruments	n.p.	n.p.	n.p.	681
3841, 3843, 3845	Motor vehicles, ships & aerospace	6	1,180	750	1,193
3320	Furniture	9	766	624	658
3900	Other manufacturing nec	4	1,232	812	622
4000	Electricity, gas & water supply	1	n.p.	n.p.	n.p.
5000	Construction	8	506	3,373	2,928
6100	Wholesale, retail trade & motor	70	13,944	11,290	11,094
7100	Transport & storage	5	182	9,460	2,075
7200	Telecommunications	n.p.	n.p.	n.p.	n.p.
8100	Financial intermediation	7	359	6,051	2,504
832320	Software consultancy	16	15,154	21,488	17,575
832310	Other computer services nec	9	821	568	996
9320	Research & development	18	12,668	6,716	3,492
8300	Other business activities nec	78	14,275	16,197	14,952
9000	Community, social & personal services	39	1,901	4,724	4,474
	Total	660*	240,315	247,890	204,839
Producer Boards and Research Associations**		10	63,050	59,273	52,653

* *Total number of firms has been adjusted for non-response rate.*

Industry totals have not been adjusted, and will not sum to the TOTAL

** *Data included in the "TOTAL" row*

1.5.2 Type of R&D expenditure in the business sector

Enterprises were asked to indicate how they spent their R&D funds. Results are given in Table 12. Wages and salaries consumed 50% of the $240.3 million allocated to R&D in the business enterprise sector, dropping by 6.3% from 1993/94. Other current expenditures accounted for 39.7%, compared with 33.5% in 1993/94. Capital expenditures were 10.3%, compared with 14.8% in 1993/94.

1.5.3 Number of enterprises and R&D staff, by industry group

In Table 13, statistics are given for the 11 industry groupings on the number of enterprises undertaking R&D, expenditure on intramural R&D, and full-time equivalent R&D personnel.

The survey shows an increase of 55 personnel doing R&D (2%). The largest overall increase (from 405 to 511) occurred in electrical machinery. The next largest was in engineering and scientific services (from 294 to 350).

The last four columns show the expenditure on R&D per full-time equivalent R&D staff member, an indicator of R&D intensity. This decreased, in total, by 4.5% over the previous year. On an industry basis, the highest expenditure, per person, was in financial and software development services followed by that of chemicals, food, textiles, plastics production.

Table 12. Type of R&D expenditure, by industry group 1995/96

		R&D expenditures ($000)			
NZSIC	Industry group	Salaries & wages	Other current expenditure	Capital expenditure	Total
1000	Agriculture, forestry & fishing	4,881	6,886	860	12,628
2000	Mining	474	n.p.	n.p.	618
3100	Food products and beverages	29,224	24,209	6,276	59,709
3140	Tobacco products	0	0	0	0
3210	Textiles	9,052	n.p.	n.p.	22,050
3220	Wearing apparel & fur	373	n.p.	n.p.	605
3231	Leather products & footwear	1,600	637	321	2,558
3310, 3410, 3420	Wood products, pulp & paper	2,377	3,846	777	7,001
3510	Chemical products less pharmaceuticals	4,619	3,293	1,215	9,127
3522	Pharmaceuticals	1,397	n.p.	n.p.	3,190
3550	Rubber & plastic products	1,967	1,528	234	3,729
3600	Non-metallic mineral products	1,343	n.p.	n.p.	2,336
3710	Basic metals, ferrous	671	391	n.p.	1,063
3720	Basic metals, non-ferrous	375	138	n.p.	576
3810	Fabricated metal products	2,048	1,278	161	3,488
3820	Machinery, nec	4,449	2,300	667	7,416
3825	Office, accounting & computing equipment	n.p.	n.p.	n.p.	n.p.
3830	Electrical machinery	11,823	n.p.	n.p.	22,012
3832	Electrical equipment, radio, TV	8,508	4,181	1,446	14,135
3850	Medical, precision, & optical instruments	n.p.	n.p.	n.p.	n.p.
3841, 3843, 3845	Motor vehicles, ships & aerospace	839	283	57	1,180
3320	Furniture	542	n.p.	n.p.	766
3900	Other manufacturing nec	230	n.p.	n.p.	1,232
4000	Electricity, gas & water supply	n.p.	n.p.	n.p.	n.p.
5000	Construction	341	153	20	514
6100	Wholesale, retail trade & motor	6,720	6,194	1,005	13,919
7100	Transport & storage	85	57	41	182
7200	Telecommunications	n.p.	n.p.	n.p.	n.p.
8100	Financial intermediation	168	140	52	359
832320	Software consultancy	7,878	6,711	565	15,154
832310	Other computer services nec	484	190	148	821
9320	Research & development	6,755	4,370	1,544	12,668
8300	Other business activities nec	6,982	4,984	2,288	14,254
9000	Community, social & personal services	935	783	182	1,901
	Total	120,119	95,431	24,733	240,315

Table 13. Number of enterprises and R&D staff, by industry group

	Industry of Enterprise	Enterprises undertaking R&D				R&D personnel FTE ($000)				R&D Expenditure per FTE (&000)			
		1995/96 all	PB & RA*	1993/94 all	1992/93 all	1995/96 all	PB & RA*	1993/94 all	1992/93 all	1995/96 all	PB& RA*	1992/93 all	1993/94 all
NZSIC Codes	Description												
1000	Agriculture, Forestry and Fishing	38	n.p.	25	25	150	26	100	60	84	n.p.	91	115
2000,371,372, 381	Mining, basic metals and metal fabrication	38		40	46	85		131	109	68		84	69
351,352,354	Chemicals (fertilisers, pesticides, paint, drugs)	33		37	51	133		130	119	93		80	93
310, 320, 355, 356	Food, textiles, plastics production	101	7	113	136	951	612	992	945	93	94	85	79
3830, 3832	Electrical machinery (electronic, appliances)	46		50	55	511		405	380	71		79	73
3820,3825, 3850	Machinery (industrial, office, instruments)	49		59	55	128		145	119	76		81	78
330, 340, 360, 390	Other manufacturing (wood, paper, concrete)	35	n.p.	44	61	124	n.p.	71	70	91	n.p.	124	91
384	Transport equipment (railroad etc.)	7		6	11	17		11	14	69		87	85
4000-7000	Infrastructure services	86		98	90	199		213	177	87		113	91
8000 except 8324	Financial, software development services	70		80	98	205		307	231	103		116	123
8324, 9000	Engineering, scientific services	117	n.p.	122	123	219	26	277	231	74	n.p.	76	84
1000-9000	Total	660**	10	675	751	2,835	683	2,780	2,446	85	92	89	84

• Producer Boards and Research Associations (these are included in "all" data)
n.p. = Not published for reasons of confidentiality

** Total number of firms has been adjusted for non-response rater
Industry totals have not been adjusted, and will not sum to the total

1.6 FUNDING OF R&D EXPENDITURE IN THE BUSINESS SECTOR

1.6.1 Source of funds for intramural R&D

The business enterprise sector used its own funds, the funds of other firms and government, and funds from overseas sources in order to carry out its intramural R&D of $240.3 million. The funding from these sources is shown in Table 14 for the last three survey years.

Table 14. Source of funds for intramural business enterprise R&D

	1995/96		1993/94		1992/93	
Source of Funds	($000)	(%)	($000)	(%)	($000)	(%)
Own Funding	153,473	63.9	170,097	68.6	130,948	63.9
Other Private NZ Firms	54,504	22.7	51,392	20.7	50,657	24.7
Foundation for Research Science Technology (FRST)	14,236	5.9	12,555	5.1	11,657	5.7
NZ Central Government	2,046	0.9	4,097	1.7	4,253	2.1
NZ Local Government	207		830	0.3	731	0.4
Overseas	13,778	5.7	8,349	3.4	6,368	3.1
Other Sources of Funds (PNP)	2,070	0.9	570	0.2	224	0.1
Total	240,315	100	247,890	100	204,839	100

Note: NZ Tertiary Education Sector is included in Central Government.
Columns will not always agree with totals shown due to rounding of individual estimates
PNP: Private non-profit

In 1995/96, the amount of business enterprise R&D funded from within the resources of the organisation doing the research decreased, both as a proportion of the total and in actual value. "Own funds" decreased by $16.6 million to $153.5 million from 68.6% of the total to 63.9%.

Fourteen percent of the research performed in the business enterprise sector was funded from outside the sector (from overseas and government), which was slightly more than previous year (11%). The total contribution from the New Zealand Central Government (including FRST) was at the same level as in 1993/94. Contributions from overseas were 5.7%, up from 3.4% in 1993/94.

Of the funds coming from outside the business enterprise sector, $14.2 million came from the Foundation for Research, Science and Technology (FRST) and $2.3 million from central and local government. A further $13.8 million came from overseas. The equivalent 1993/94 figures are $12.6 million from FRST, $4.8 million from the rest of government, and $8.3 million from overseas. Firms have decreased funding from their own sources while there was an increase in funds from other New Zealand firms (up $3.1 million). There has also been an increase in funds from overseas (up $5.4 million) and unspecified sources (up $1.5 million).

The proportion of industry funds used for R&D carried out by the New Zealand business enterprise sector (86.5%) is in line with the six OECD reference countries, where this figure averages 86.6% for the most recent available years. The portion of business enterprise R&D financed by government (including local government) is 6.9%, lower than the average OECD reference country figure of 8.5%.

1.6.2 Additional research funded but not performed in the sector (extramural R&D)

In addition to the R&D carried out within the business enterprise sector, business enterprises reported they funded $17.6 million worth of research carried out by government organisations, $8.6 million by the universities and $10.8 million overseas. A total of $40.8 million was research funded by the business sector and carried out outside the sector. This compares with $43.1 million in 1993/94.

(Business enterprises stated that they also *funded* $54.0 million of research which was carried out by other business enterprises, i.e. within the business enterprise sector, compared with the reported receipt of $54.5 million from other NZ firms for R&D.)

1.6.3 Extramural R&D, by industry group

Table 15 provides information by industry group about all R&D funded by a business enterprise but carried out by other enterprises, institutions or individuals. This includes R&D carried out by other business enterprises (which was presumably reported in intramural R&D by other businesses). A total of $94.8 million was spent on extramural R&D, including funds circulating within the business sector. This is an 8% increase from 1993/94.

Funders of R&D stated that other business enterprises were funded a total of $54 million. Some of these funds may have been reported twice, as it is not uncommon for funds for research to be sub-contracted or passed to a funding organisation to be allocated; in which case, both funders would report the same R&D.

Another way of estimating extramural R&D funded by business is to aggregate information from the business, government and university surveys about the sources of their funds (see Chapter 4) where the estimate of extramural business-funded R&D would be $145.2 million compared with the $94.8 million reported as being funded extramurally by the business sector survey.

A total of $10.9 million is spent by the business enterprise sector on R&D carried out overseas.

Half of the R&D carried out extramurally was funded by the producer boards ($46.3 million). Producer boards spent $35.5 million funding R&D in private sector enterprises, $5.8 million in the government sector, and $5 million divided between the universities and overseas organisations.

Engineering and scientific services were the next largest funder of extramural R&D. Most of that money (98.6%) was spent evenly in government, university and other private sector enterprises. Infrastructure services, which was the fourth largest funder in 1993/94, became the third largest in 1995/96.

1.6.4 Total R&D funded by the business enterprise sector

As noted in section 1.3, the "official" estimate of business sector funding of R&D comes from balancing the provider information from the three sectors. This figure amounts to $299.2 million (or $310.1 million including funding of overseas research).

However, the business sector reported that they performed $240.3 million on R&D. Subtracting the $32.3 million they obtained from outside the business sector and adding in the $40.8 million they spent on R&D performed outside the sector including overseas, their reported funding amounted to $248.8 million. The difference between these two estimates arose because of the higher reported receipt by the government sector of funds from business than business said they gave to the government sector. This may be due to a large number of small funding contracts for CRIs to undertake research from firms who are not captured in the R&D survey. It is therefore anticipated that the higher "official" figure which is used later in this report is more accurate. This is discussed further in section 2.5.

Table 15. Extramural R&D funded by business enterprises, 1995/96, by industry group

Industry of Enterprise		Sector of Recipient of R&D Funding ($000)						
NZSIC Codes	Description	Number of Enterprises	Government*	Universities	Other Business Enterprises	Overseas Organisations	Total ($000)	Increase since prev. survey year ($000)
1000	Agriculture, Forestry and Fishing	19	2,445	188	2,366	826	5,823	3,581
2000, 371, 372, 381	Mining, basic metals and metal fabrication	11	11	261	1,675	399	2,346	509
351, 352, 354	Chemicals (fertilisers, pesticides, paint, drugs)	16	1,239	96	1,695	175	3,205	1,202
310, 320, 355, 356	Food, textiles, plastics production (firms)	45	738	815	1,863	2,702	6,118	2,003
	Food, textiles, plastics (producer boards)	7	5,832	1,449	35,551	3,511	46,343	-4,398
330, 340, 360 382-385, 390	Electrical and other machinery and other Manufacturing	32	979	355	2,728	1,071	5,133	-857
4000-7000	Infrastructure services	69	5,203	830	1,383	2,029	9,446	3,480
8000 except 8324	Financial, software development services	8	367	12	412	22	813	97
8324, 9000	Engineering, scientific services	47	4,423	4,649	6,314	214	15,600	1,368
	Total 1995/96	254	21,237	8,656	53,986	10,948	94,826	7,011
1000-9000	Total 1993/94	227	19,718	9,059	44,754	14,283	87,815	2,010
1000-9000	Total 1992/93	287	16,069	8,728	45,999	15,008	85,805	-11,511
1000-9000	Total 1991/92	283	19,209	8,660	54,974	14,474	97,316	14,757

• Local authorities are included in the Government column

1.6.5 Intramural estimate of total R&D funded by the business enterprise sector, by output area

Table 16 shows estimates of the amount of business sector funds going to R&D in each output area. These estimates do not include the extra business funding reported by the government ($44 million) and university ($17 million) sectors which could not be allocated to the 40 output areas.

To obtain the estimates for intramural R&D funded solely by business enterprises (see column 2, Table 16), funding from all sources outside the firm was deducted from the value of each enterprises intramural R&D, in the same proportion per output class as the proportion for total research carried out.

The allocation of business-financed extramural R&D carried out by firms, universities, government organisations or overseas to output classes had to be estimated because the survey asked only for the allocation of total R&D. If the enterprise carried out R&D it was assumed that it would fund in these same output areas. If it simply funded R&D, then the industrial classification was used to allocate the funds to the most likely outputs. The larger producer boards were asked for more information. The resulting estimates of total extramural expenditure on R&D in each output by the business enterprise sector, are shown in the third column.

Dairy processing is the largest single target of private sector R&D funds, with $39 million spent in New Zealand or overseas, although this decreased by $6 million from 1993/94.

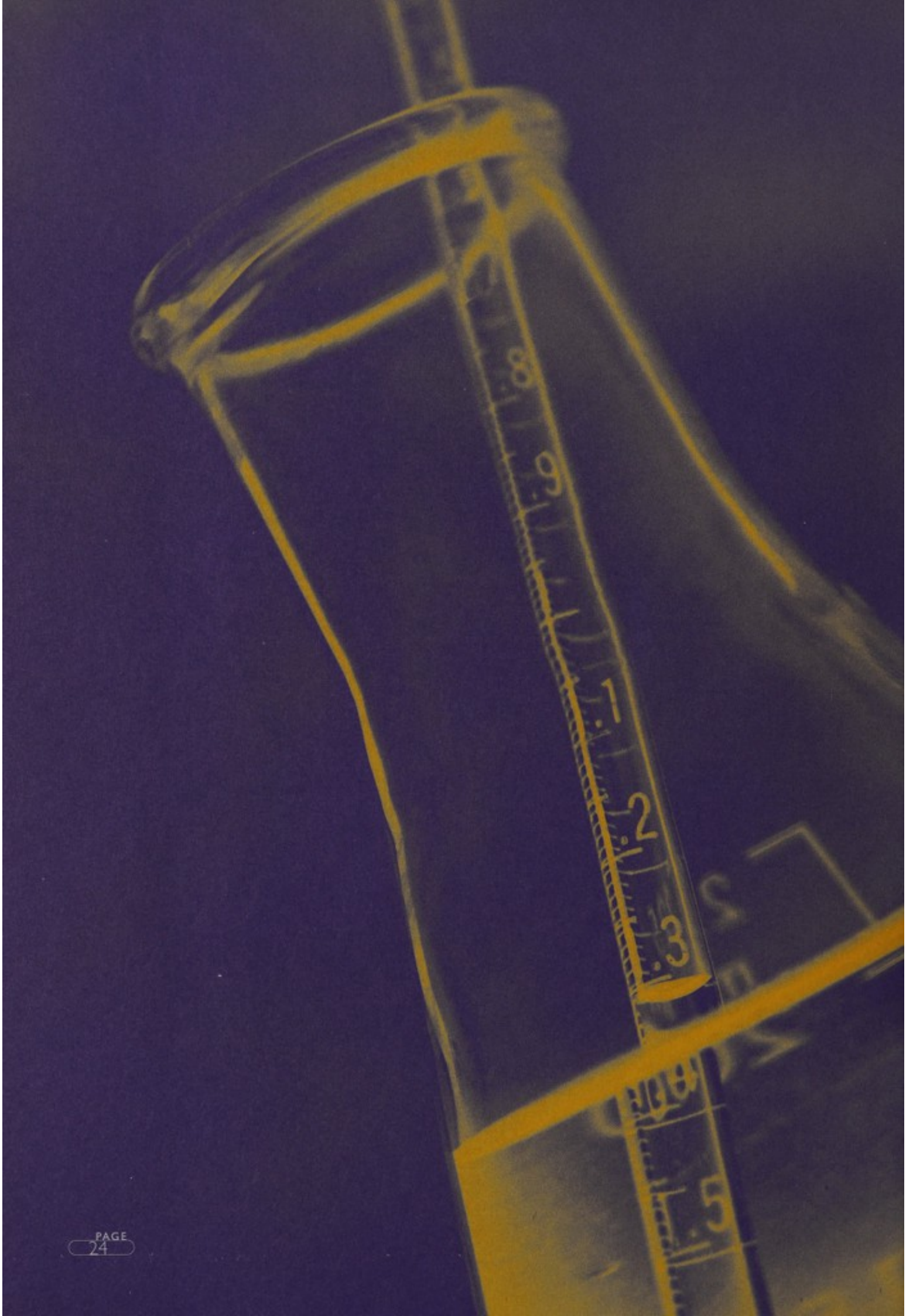
Output classes 18 (electronics and instruments) and 23 (information and communications services) should be considered together. The first includes the "hardware" aspects of computer microprocessor and communications R&D, and the second is "software" R&D into new programming languages and operating systems. These two areas are closely linked. Together they account for 13.9% of private sector funding for R&D (17% of all research carried out in the private sector).

Engineering processes - output class 17 ($24.7 million), and fibre, textiles & skin processing - output class 14 ($20.5 million) are the next largest areas of business enterprise R&D funding.

Table 16. Estimates of business enterprise funding of R&D, by output area, 1995/96

Science output area		R&D funded, ($000) Intramural	Extramural	Total
01	Sheep Production	1,414	2,415	3,829
02	Beef Production	528	967	1,495
03	Dairy Production	3,636	5,471	9,108
04	Alternative Animal Species	560	209	769
05	Generic Animal Research	1,540	645	2,185
06	Forage Plants	2,935	2,205	5,141
07	Horticulture	2,410	7,539	9,949
08	Arable crops and other Plants	1,786	848	2,634
09	Plantation Forestry	5,153	4,851	10,004
10	Fisheries	1,073	38	1,111
11	Meat Processing	6,171	6,754	12,925
12	Dairy Processing	9,660	29,263	38,924
13	Other Food Processing	7,357	5,353	12,710
14	Fibre , Textile & Skin Processing	12,759	7,722	20,481
15	Wood & Paper Processing	7,035	2,455	9,490
16	Materials & Industrial Processing	6,201	1,193	7,394
17	Engineering	22,612	2,088	24,700
18	Electronic & Instruments	19,252	326	19,577
19	Construction	5,486	508	5,994
20	Commercial & Trade	2,792	232	3,024
21	Energy	3,307	4,907	8,214
22	Transport Services	2,079	121	2,200
23	Information & Communications	14,768	277	15,045
24	Urban & Rural Planning	n.p.	n.p.	n.p.
25	History, Society & Culture	21	n.p.	n.p.
26	Relationships & Wellbeing	188	n.p.	n.p.
27	Political & Economic Relationships	1,256	115	1,371
28	Education, Knowledge & Training	116	42	158
29	Environmental Protection	2,391	746	3,136
30	Geological Structure & Process	n.p.	50	n.p.
31	Land use, Flora & Fauna	n.p.	n.p.	n.p.
32	Marine & Fresh Waters	173	n.p.	n.p.
33	Climate & Atmosphere	535	n.p.	n.p.
34	Space	n.p.	n.p.	n.p.
35	Antarctica	n.p.	n.p.	n.p.
36	Fundamental Knowledge	n.p.	n.p.	n.p.
37	Health	9,509	6,565	16,074
38	Defence	n.p.	n.p.	n.p.
	Other	n.p.	n.p.	n.p.
	Total	155,759	94,096	249,855

n.p. = Not published for reasons of confidentiality



2 GOVERNMENT

2.1 KEY RESULTS

- Research funded by the government sector increased overall by $14.7 million in 1995/96, but this amounted to a decrease in government expenditure as a % of GDP, from 0.56% to 0.52%.
- Although the reported funding received from the private sector for R&D carried out by government agencies increased dramatically by $20.1 million, this is mostly the result of a reassessment of the data by the CRIs.
- Over the five years from 1990/91 to 1995/96 New Zealand's government funding of R&D has dropped from 0.60% to 0.52% of GDP. The average for other OECD countries decreased from 0.90% to 0.69%, while for the reference countries it has dropped slightly from 0.72% to 0.71%.
- Research expenditures in the government sector (i.e. R&D performed rather then funded) increased overall by $32 million (9%) to $375.6 million (or 0.42% of GDP). The proportion of funds that came from FRST decreased while the proportion from 'own funds' and the private sector increased.
- Research into primary production increased by almost 30%, and into the processing of primary products by 7%. Research into materials engineering, infrastructure and the environment, exploration and assessment of the earth decreased in total by $20 million, or by 13%.

2.2 OUTLINE OF THIS SECTION

After a brief introduction, section 2.4 shows R&D carried out by government in each science output class, and compares this with that carried out by the business sector as described in the previous section. Changes in the amount of R&D carried out by government since the previous year are also noted.

Section 2.5 shows where the funding for government R&D came from, and how much research was done in other sectors with government funds. Estimates of government funding of R&D by science output class are provided.

2.3 GOVERNMENT SECTOR: INTRODUCTION

During 1991/92, the main Government science departments underwent major restructuring. On July 1992, 10 CRIs commenced operations and the DSIR, MAF Technology, Forestry Research Institute and the Met Service ceased to exist. This is the third time that CRIs have responded to the survey, there was no survey in 1994/95. There may still be different interpretations of just what constitutes R&D as distinct from scientific and technological services. In some cases, this must be estimated as it cannot be obtained directly from the respondent's accounting system.

The government sector organisations included in this survey are listed in Annex 1. These exclude agencies surveyed previously which have indicated that they are not involved in research. There was a 100% response rate from the organisations listed in Annex 1.

As noted previously (see section 1) the science output classes are used in setting Government priorities and funding levels. Various groupings of these output classes have been used. This section describes the outputs according to the sub-groups for primary production, primary product processing, etc. The grouping by the 15 areas of science used in the 1995 priority setting are shown in Figure 2 in the Executive Summary.

Table 17. Intramural R&D in the government and business sectors, 1995/96

Output areas	Government ($000)	Total	%	Group % of group	Business ($000)	Total	%	Group % of group
	Primary production							
01	Sheep (meat)	1,708		0.9	233			0.7
01	Sheep (wool)	2,602		1.4	1,057			3.3
01	Sheep (general)	14,630		8.0	297			0.9
02	Beef Production	{8,764}		{4.8}	721			2.2
03	Dairy Production	{ }		{ }	5,780			18.0
04	Alternative Animal Species	6,966		3.8	563			1.8
05	Generic Animal Research	16,395		9.0	1,542			4.8
06	Forage Plants	32,400		17.7	4,583			14.3
07	Horticulture	38,907		21.3	3,817			11.9
08	Arable crops and other Plants	16,154		8.8	3,466			10.8
09	Plantation Forestry	19,658		10.8	8,319			25.9
10	Fisheries	24,541	182,726	49 13.4	1,712	32,088	13	5.3
	Primary products and processing							
11	Meat Processing	2,687		7.4	14,242			15.9
12	Dairy Processing	1,082		3.0	37,303			41.6
13	Other Food Processing	{16,924}		{46.7}	7,739			8.6
14	Fibre, Textile & Skin Processing	{ }		{ }	23,507			26.2
15	Wood & Paper Processing	15,577	36,271	10 42.9	6,839	89,630	37	7.6
	Materials engineering							
16	Materials & Industrial Processing	13,718		53.7	6,621			11.9
17	Engineering	4,047		15.8	26,369			47.4
18	Electronic & Instruments	7,775	25,541	7 30.4	22,673	55,662	23	40.7
	Infrastructure							
19	Construction	{2,571}		{21.1}	8,641			23.1
20	Commercial & Trade	{ }		{ }	2,707			7.2
21	Energy	5,482		45.0	4,796			12.8
22	Transport Services	1,579		13.0	2,906			7.8
23	Information & Communications	1,671		13.7	17,962			48.0
24	Urban & Rural Planning	874	12,177	3 7.2	380	37,393	16	1.0
	Social sciences							
25	History, Society & Culture	4,587		31.2	212			7.7
26	Relationships & Wellbeing	3,961		26.9	624			22.6
27	Political & Economic Relationships	3,819		26.0	1,528			55.4
28	Education, Knowledge & Training	2,338	14,705	4 15.9	396	2,760	1	14.4
	Environment							
29	Environmental Protection	14,741		15.7	4,440			65.5
30	Geological Structure & Process	13,855		14.7	627			9.2
31	Land use, Flora & Fauna	16,910		18.0	174			2.6
32	Marine & Fresh Waters	30,808		32.7	928			13.7
33	Climate & Atmosphere	14,905		15.8	541			8.0
34	Space	{2,962}		{3.1}	n.p.			n.p.
35	Antarctica	{ }	94,182	25 { }	n.p.	6,784	3	n.p.
	Miscellaneous							
36	Fundamental Knowledge	300		3.0	n.p.			n.p.
37	Health	2,665		26.5	15,958			99.8
38	Defence	{7,082}		{70.5}	n.p.			n.p.
	Other	{ }	10,048	3 { }	n.p.	15,998	7	n.p.
	Total	375,649	375,649	100 100	240,315	240,315	100	100

n.p. = Not published

{} 2 cells combined for confidentiality

2.4 GOVERNMENT R&D (GOVERD) CARRIED OUT IN EACH SCIENCE OUTPUT CLASS

Total intramural government sector R&D (GOVERD), by science output area, is shown in Table 17.

2.4.1 Primary production

As in 1993/94, the major effort in government R&D (49%) was in primary production (output classes 1 to 10). In absolute terms, it received over five times more funding in the government sector than in the business enterprise sector ($183 million versus $32 million). Government provided $40 million more research than in 1993/94 and the business sector also increased its R&D by $9 million in these output classes.

Of the 10 component output classes, eight are devoted to agriculture, with the remaining two devoted to forestry and fishing.

Output class 7 (new and improved horticultural crops, including vegetables and management practices) accounted for 21% of primary production R&D, followed by forage plants (18%), fisheries (14%), trees and plantations (11%).

The amount of R&D carried out in each output area within primary production was quite different for government and business enterprise sectors. Horticulture was the largest area in the government sector and forestry was the largest in the business enterprise sector.

2.4.2 Primary product processing

R&D in the area of primary product processing (output classes 11 to 15) was a relatively minor component of government sector R&D (10%), but it comprised 37% of the business enterprise sector's R&D. The total government sector R&D in this area was $36 million, which is 37% of the R&D carried out in the business enterprise sector ($90 million). This is $2.5 million more research done by Government (an increase of 7.3%), and $3.6 million more by business (an increase of 4.2%) than in 1993/94.

Virtually all the government sector R&D in primary product processing was concentrated in output classes 13 (new and improved fruit, crops and other food and beverage processes, storage techniques and products) and 15 (new and improved wood and paper processes and products). These comprised 44% and 43% of the primary product processing R&D effort, respectively.

Output class 12 (new and improved dairy processes, storage techniques and products) received only 3.2% of the government sector's R&D effort. However, it was the most heavily funded component ($37 million) of the business enterprise sector's R&D, comprising 41.6% of the total effort in the processing areas.

2.4.3 Materials, engineering, computing and communications

Although R&D in the area of materials, engineering and electronic & instruments (output classes 16 to 18) accounted for 23% of the expenditure in the business enterprise sector ($55.6 million), it was of less importance in the government sector ($25.5 million, 7% of total funding). Compared to 1993/94 results, the Government figures showed a decrease (13%) while business had a small increase (2%).

Output class 18 (new and improved computing and electronic, communication and instrumentation processes, systems and products, with the emphasis being on computer hardware) was the fourth most heavily funded class in the business enterprise sector ($22.7 million). In the government sector it was funded about $8 million. However, it must be borne in mind that information technology (IT) is becoming such a basic tool that it is harder to distinguish whether research is primarily IT-related or whether it is related to some application of IT. Taking a broader definition of IT-related research would probably result in a large addition to the government sector's expenditure.

Similar arguments apply to output class 23 (new and improved information processing software, software and services for electronic communication, media transmission and data exchange). If the two output classes (18 and 23) are taken together, it is clear that computing systems are the largest area of business enterprise sector R&D in New Zealand, with a total expenditure of $40.6 million, or 17% of all the business enterprise sector's R&D. The comparable value for government sector R&D in these two output classes is only about $9.4 million, or 2.5% of government sector R&D.

In the government sector, output class 16 (new and improved materials, industrial processes and products) received the largest portion of the R&D funding (53.7%). Output class 17 (new and improved engineering processes, systems, and production) received 15.8% and output class 18 received 30.4%.

By contrast, output class 17 received about half of the business enterprise sector's funding R&D for this group (47.4%), while outputs 16 and 18 received 11.9% and 40.7% respectively.

2.4.4 Infrastructure and services

Infrastructure and services R&D (output classes 19 to 24) was better funded in the business enterprise sector than in the government sector, representing 16% and 3% of total research expenditures, respectively. Compared with 1993/94, government R&D has remained virtually unchanged, while business R&D has decreased by $25.7 million or 40.8%. The major decrease in the business sector as mentioned in section 1.4.9 is because some big R&D projects in 1993/94 were one off programs. The major government effort in this area was in energy production, comprising 45% of the total, followed by construction and commercial and trade (21%), and information and communication (13.7%).

2.4.5 Social sciences

The government sector provided $14.7 million of research (down $8.2 million) in this area, private enterprise provided $2.7 million worth of research (55.4% of which was in political and economic relationships).

2.4.6 Environment, exploration and assessment of the earth

A quarter (25%) of the R&D funding in the government sector was in the area of environment, exploration and assessment of the earth, i.e. in output classes 29 to 35. By contrast, this kind of research comprised only 3% of the R&D of the business enterprise sector. Government research in this area has increased by $10.9 million (13%); business research in the environment has increased as well ($1.3 million or 24%).

Output classes 30, 31 and 32, which deal with geological structures, land use, flora and fauna, and marine and fresh waters, together comprised about two-thirds of the government expenditure in this group (65.4%). Output class 33, which deals with R&D in the field of climate and atmosphere, was the next most important (15.8%) followed by output class 29, environmental protection (15.7%).

2.4.7 Miscellaneous

Within the miscellaneous sector there was a decrease in health research (4.2%). Government R&D into fundamental research showed a decrease in 1995/96 of over $3 million, but this was due to the introduction of a separate fund for fundamental research (now called the Marsden Fund) and a reclassification of these projects into Output 7.

2.5 FUNDING OF R&D EXPENDITURE IN THE GOVERNMENT SECTOR

2.5.1 Source of funds for intramural R&D

In the survey, government organisations were asked to provide information on the source(s) of the funds for the R&D they undertook. The results are summarised in Table 18. Compared with that in 1993/94, the proportion of funding received from FRST decreased by 3% while the proportion made up of "own funds" increased by 0.3%. The proportion received from the private sector increased by 4.2%.

The bulk of funding (58.2%) came from FRST, which allocates funds from the PGSF. This increased in value by $8.6 million since 1993/94.

The second largest portion of funds for R&D in government are from the New Zealand business sector, representing 17.1%. This is the first time that the business sector has been the second largest funder in government R&D since 1991/92.

A further 7.7% of funding came from "own funds", and 12.9% from other New Zealand central government agencies.

Table 18. Source of funds for R&D carried out in the government sector

Source of Funds	1995/96 ($000)	(%)	1993/94 ($000)	(%)	1992/93 ($000)	(%)
Own Funds	28,814	7.7	25,552	7.4	17,418	5.5
Foundation of Research Science and Technology	218,806	58.2	210,211	61.2	203,554	64
Other NZ Central Government Agency	48,421	12.9	51,813	15.1	53,834	16.9
NZ Local Government	4,288	1.1	2,381	0.7	2,720	0.9
Tertiary Education Sector	676	0.2	136	0.04	205	0.1
Business Sector NZ Enterprises	65,575	17.5	45,498	13.3	33,404	10.5
Funds from Abroad	7,134	1.9	4,112	1.2	4,478	1.4
Other Sources of Funds	1,936	0.5	3,696	1.1	2,408	0.8
Total	375,649	100	343,339	100	318,021	100

Although the business sector reported that it spent $21.2 million for R&D carried out by the government sector, the government sector in turn reported $65.6 million sourced from the business sector. There are several likely reasons for the $44.4 million discrepancy:

- CRIs may include S&T service and consults work in their reported data;
- Small CRI clients may not be on the R&D population base for the survey; and
- The TBG scheme (technology for business growth) may be counted as research by CRIs but not by their business partners.

2.5.2 Extramural R&D, by sector of R&D provider

Government agencies funded R&D carried out by other organisations in the government, business and university sectors, as shown in Table 19. By far the majority of extramural R&D research (72.9%) was carried out by other Central Government agencies, including CRIs.

Table 19. Extramural R&D funded by the government sector, 1995/96

R&D Provider	*($000)*	*(%)*
Other NZ Central Government Agency	*237,722*	*72.9*
NZ Local Government Organisations	*790*	*0.2*
Tertiary Education Sector	*45,752*	*14.0*
Private Sector NZ Enterprises	*39,529*	*12.1*
Overseas Organisations	*1,241*	*0.4*
Other Organisations	*1,246*	*0.4*
Total	*326,280*	*100.0*

2.5.3 Total R&D funded by the government sector

Total funding of research by the government sector stayed at the same level as in 1993/94 ($450.4 million in 1993/94 and $450.6 million in 1995/96). R&D funded in each science output class can be estimated from the proportion of R&D carried out with 'own *funds*' and R&D funded extramurally (assuming R&D is funded to output classes in the same proportion as the respondent's intramural R&D). Information from funders' research schedules, non-specific output funds (NSOF) to CRIs, and information from the university survey about general university funds (GUF) were added to provide the estimates in Table 20. Because of gaps in these estimates the total does not add to $466.7 million (see Table18), but the estimates match to within 4%.

Table 20. Estimates of government funding of R&D

Science output class	R&D funded ($000) 1995/96	1993/94
01 Sheep Production	13,812	14,982
02 Beef Production	6,048	2,632
03 Dairy Production	9,720	6,416
04 Alternative Animal Species	6,403	6,087
05 Generic Animal Research	20,400	13,410
06 Forage Plants	23,910	24,816
07 Horticulture	28,744	30,815
08 Arable crops and other Plants	19,275	13,548
09 Plantation Forestry	16,033	14,624
10 Fisheries	6,040	17,071
11 Meat Processing	3,874	4,328
12 Dairy Processing	4,599	4,397
13 Other Food Processing	10,646	12,464
14 Fibre, Textile & Skin Processing	3,928	3,588
15 Wood & Paper Processing	10,148	10,309
16 Materials & Industrial Processing	16,996	16,398
17 Engineering	7,068	6,742
18 Electronic & Instruments	12,724	12,144
19 Construction	4,052	4,601
20 Commercial & Trade	4,476	3,862
21 Energy	9,527	7,764
22 Transport Services	3,910	2,985
23 Information & Communications	4,630	4,244
24 Urban & Rural Planning	2,460	1,870
25 History, Society & Culture	10,292	11,803
26 Relationships & Wellbeing	8,751	8,640
27 Political & Economic Relationships	11,012	9,241
28 Education, Knowledge & Training	8,464	11,917
29 Environmental Protection	16,391	17,152
30 Geological Structure & Process	14,472	14,860
31 Land use, Flora & Fauna	14,800	17,317
32 Marine & Fresh Waters	18,999	19,633
33 Climate & Atmosphere	9,147	9,501
34 Space	184	485
35 Antarctica	2,189	2,394
36 Fundamental Knowledge	26,573	30,701
37 Health	54,425	46,397
38 Defence	5,393	5,200
Other	100	5,044
TOTAL	450,614	450,382

3 UNIVERSITIES

3.1 KEY RESULTS

- The methodology used here was piloted in 1993 and showed that more was being spent on R&D carried out in the university sector than previous estimates had indicated. The same survey methodology was applied to obtain data for 1994 and for the 1996 figures reported here.
- Total R&D carried out in the university sector in 1996 amounted to $273.5 million, an increase of $40 million over 1994. This is a significant increase. In terms of the source of funds, funds from R&D contracts increased to $103.2 million (by 40%), funds from "own funds" (fees plus other income) increased to $74.1 million (by 38.2%) and funds from EFTS for R&D decreased to $96 million (by 9.8%).
- Research classified by field of science showed that the medical sciences took 27.5% of university R&D expenditure, followed by social sciences (23.5%), and humanities (8.4%). The natural sciences (physics, chemistry, biological and earth sciences) taken together amounted to 22% of the total.
- By science output class, the universities undertook 99% of New Zealand's research in fundamental knowledge output, 81% in health and 76% of research into social science output classes. On the other hand universities only undertook 7.8% of the research into primary production (the government sector accounted for 78%) and 6% of primary production processing (the business sector accounted for 67%).
- Sixty-two percent of the funding for university research came from internal sources; it is estimated that 35% came from general university funds from Government and 27% from the universities' own funds, which include student fees. The remainder of the funding came from business, government and other sources.

3.2 OUTLINE OF THIS SECTION

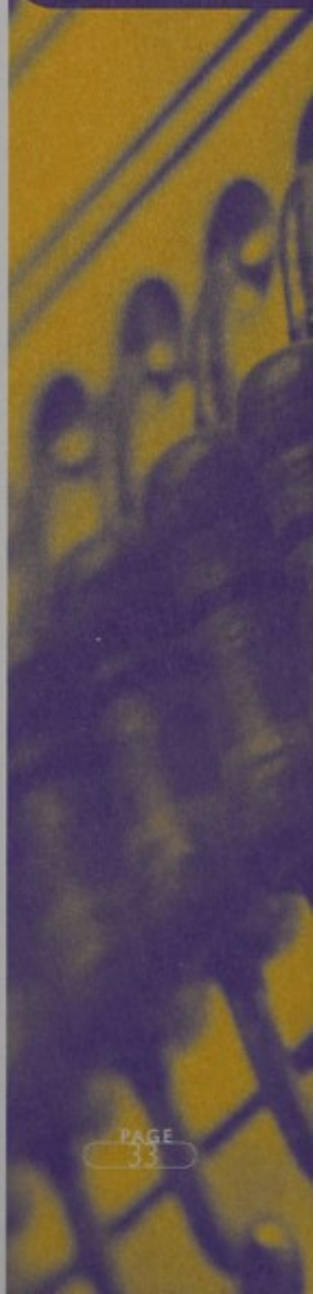
A brief introduction provides some background to previous surveys of university R&D. This is followed by a discussion of the methodology used in conducting the surveys of 1993, 1994 and 1996 data. Section 3.4 provides a summary of the results of the survey of 1996 R&D in universities.

3.3 UNIVERSITY SECTOR: INTRODUCTION

The university sector carries out research as part of its mandate with Vote Education funds, and receives funds for contract research from the Health Research Council and other Crown and private sources.

Over the last few years, a number of projects have been undertaken to gather better information on R&D expenditure in the higher education sector. Two publications in particular have analysed this information. The first of these, *A profile of Crown-funded R&D in New Zealand, 1991/92*[3], provides information for 1991 on all current university research projects, including FTE personnel engaged.

The next major study, the Bollard review[4], estimated resources used nationally for research in the non-medical university sector. It concentrated on costing that part of university research comprising public good science outputs, i.e. outside of teaching which was funded by Vote Education. The methodology is further described in the 1992/93 publication in this series[13].



This report is based on the third survey on university research developed and carried out by this Ministry with the assistance of the New Zealand University Vice-Chancellors' Committee. The statistics collected by this joint survey cover a wider range of disciplines than the first two surveys. As recommended by the OECD, research in the social sciences and humanities were included, and all university overheads were taken into account. All research which was externally funded was also included. The data collected refer to the 1996 calendar year.

Only the universities are included in the survey, although they are expected to count for most of the research in the higher education sector. It is recognised, however, that polytechnics are increasing the amount of research they are carrying out.

3.4 THE SURVEY METHODOLOGY

All heads of university departments were asked to estimate the proportion of time academic staff in their department spent on research by field of science and by socio-economic objective (science output class).

University registries supplied expenditure data for each department in three categories: salaries and wages, operating expenditure, and capital expenditure. The sources of external funds for research were also provided.

To obtain the results shown here total teaching and research expenditures were multiplied by the departmental estimate of the proportion of time spent by academic staff on research (rather than teaching), and any "research only" expenditure added to give the total expenditure on research for each department. Each department also estimated the percentage of its research which was carried out in 12 different fields of science and aimed at each of 38 socio-economic output areas. Total departmental research expenditure was allocated to fields of science and socio-economic areas according to these percentages supplied. Three new fields were added: mathematics, information and communication technologies, and applied science and technologies.

Data on personnel FTEs by occupation in the categories, academic staff, technicians, post-graduate students and support staff, was not collected for this report.

To bring the review data into line with OECD recommendations:

- Only personal scholarship carried out specifically for a research project was to be considered an R&D activity;
- Administrative and support staff providing direct project-linked administration or clerical services within the R&D unit were included in the count of FTE personnel;
- An allowance for the stipends of post-graduate research students was included in R&D personnel costs, where available;
- Research and equipment grants from external sources were included; and
- Overseas funds for research were included.

3.5 R&D CARRIED OUT IN THE HIGHER EDUCATION SECTOR (HERD)

Table 21 shows the fields of science in which the universities carried out R&D. Half of the total expenditure was in two fields: Medical Sciences and Social Sciences. The pattern is quite similar to that of the previous years.

Table 21. University R&D expenditure, by fields of science, 1996

Fields of sciences	($000)	(%)
Mathematical sciences	5,185	1.9
Physical sciences	8,337	3.0
Chemical sciences	9,252	3.4
Earth sciences	11,070	4.0
General engineering	14,618	5.3
Applied sciences and technologies	13,886	5.1
Information, computer and communication technologies	9,496	3.5
Biological sciences	25,958	9.5
Agriculture sciences & forestry	13,197	4.8
Medical and health sciences	75,240	27.5
Social sciences	64,208	23.5
Humanities	23,065	8.4
Total	273,513	100.0

Information was provided by each university department about their external sources of funds for research. Each university provided figures for the total government operating grant and all income from other sources for teaching and research, including student fees. This was used to estimate research expenditure sourced from general university funds from the Government (GUF) versus other university income. The results are shown in Table 22.

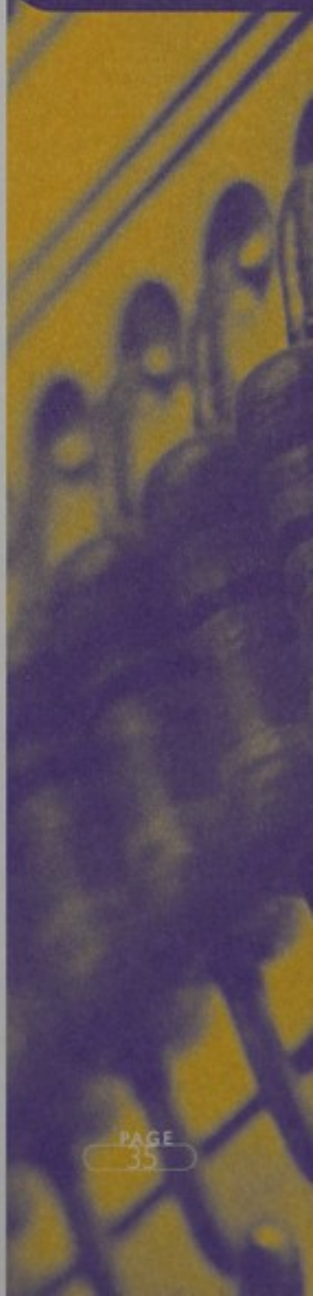
Table 22. Source of funds for intramural university sector R&D

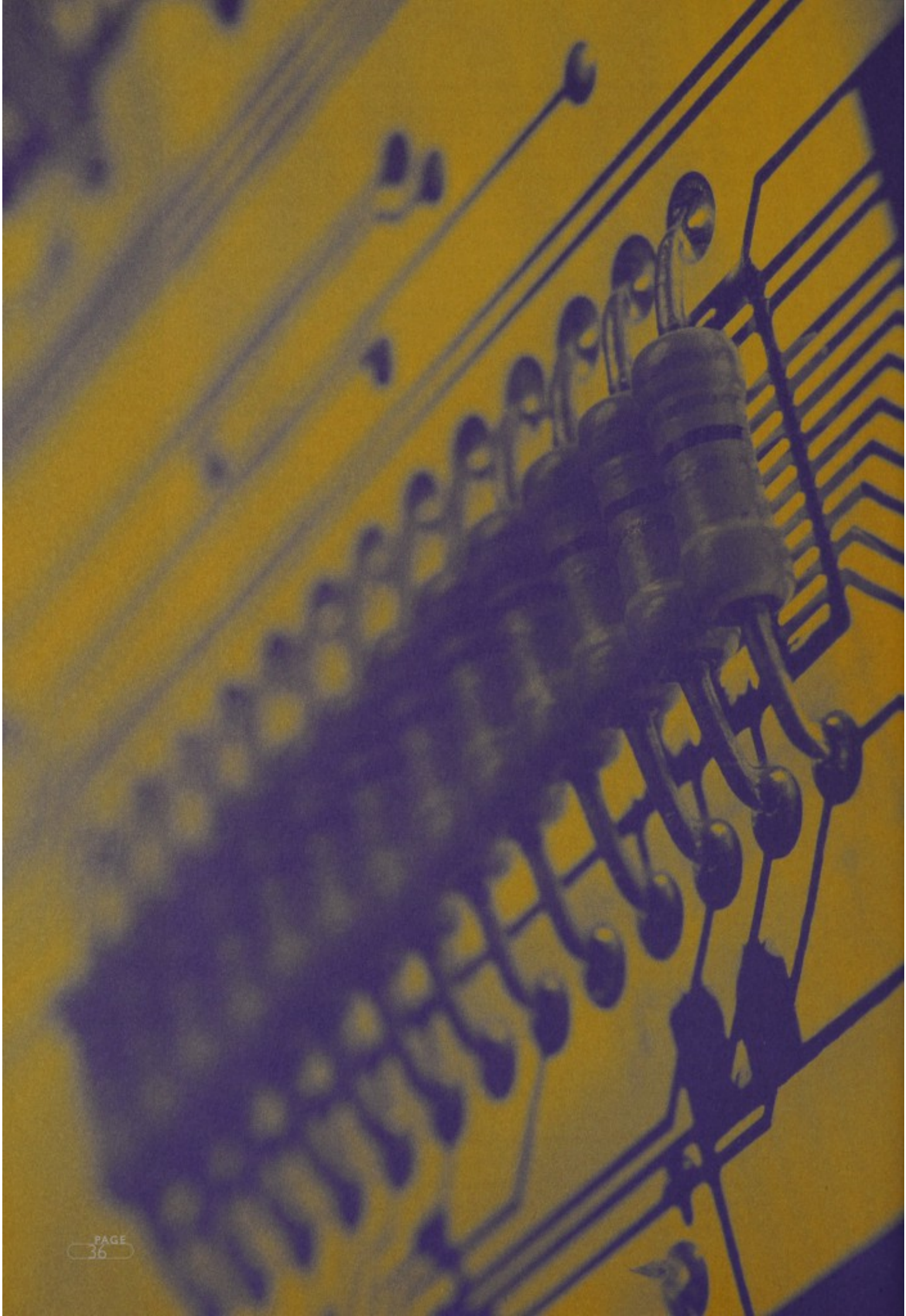
	1996		1994	
Source of funds	($000)	(%)	($000)	(%)
Own funds (includes students fees)	74,135	27.1	53,600	23.0
General university funds (GUF)	96,046	35.1	106,400	45.6
NZ Govt (includes FRST, HRC)	52,250	19.1	38,000	16.3
Local Government	1,157	0.4	200	0.1
NZ tertiary education sector	432	0.2	1,900	0.8
Private sector NZ enterprises (includes SOEs, RAs, PBs)	25,638	9.4	12,200	5.2
Funds from abroad	13,414	4.9	7,700	3.3
Private non-profit (LGB, Cancer society, etc)	10,441	3.8	13,500	5.8
Total	273,514	100.0	233,500	100.0

GUF = General University Funds
FRST = Foundation for Research, Science and Technology
HRC = Health Research Council
SOE = State Owned Enterprises
RA = Research Association
PB = Producer Board
LGB = Lottery Grants Board

University R&D expenditure increased by $40 million, to $273.5 million in 1996. This is a significant increase since 1994. Of the total of $273.5 million, 62% of these funds are from the universities' own funds and general university funds.

For all universities, total income increased by 30% from 1994 to 1996. EFTS income increased by 7%, income from student fees by 38%, and income from all other sources by 105% (Ministry of Education Statistics). In terms of funds for R&D, funds from R&D contracts increased to $103.2 million (by 40%), funds from "own funds" (fees plus other income) increased to $74.1 million (by 38.2%) and funds from EFTS for R&D decreased to $96 million (by 9.8%).





4 ALL SECTORS

4.1 KEY RESULTS

- When the three sectors of R&D provider data are added together, the result is an estimate of the total R&D carried out in New Zealand. In 1995/96 the total R&D undertaken in New Zealand was $889.5 million, up 7.8% from $824.8 million in 1993/94.
- The total R&D being funded from outside each of the sectors (excluding GUF) has risen 43.8% from $130.2 million to $187.1 million (from 16% of total R&D to almost 21% of total R&D). This indicates a greater interaction between sectors in the funding of R&D in New Zealand.
- The estimated funding of R&D by the business sector has increased from $293 million to $310 million (including the funding of research overseas). But the proportion to GDP is down from 0.35% to 0.33%.
- Although government sector funding of R&D has increased from $452.0 million to $466.7 million, as a percent of GDP this has dropped from 0.56% to 0.52%.
- Total research funds going overseas from all sectors was $12.2 million, down from $15.5 million in 1995/96, while at the same time overseas funding of research in New Zealand has increased from $20.1 million to $34.3 million.

4.2 OUTLINE OF THIS SECTION

After a brief introduction, the information provided by survey respondents in each sector on the research performed and their source of funds is combined to give a matrix of R&D funded and R&D performed across all the sectors. The R&D funded and the R&D performed by each sector are also shown as a percent of GDP and, where available, comparisons are given between New Zealand and the OECD reference countries.

Section 4.4 also compares the funding of R&D by the 38 science output classes by each of the three sectors. The contribution of each sector to the seven sub-groups of these output classes is also shown.

Section 4.5 compares the business and government sectors in terms of the type of R&D expenditure (universities did not provide this information).

4.3 ALL SECTORS: INTRODUCTION

From the information provided by respondents it is possible to determine what R&D they performed from their own funds and what was performed from funds being received from the other sectors. Within the government sectors there was a further distinction made between FRST, GUF and other government. Also, private non-profit organisations (PNPs), and overseas were included separately.

As mentioned previously, the provider data is used to construct this matrix because it is expected to be more reliable.

4.4 SOURCE OF R&D FUNDS, SECTOR OF PERFORMANCE AND OUTPUT CLASS, FROM PROVIDER DATA, ALL SECTORS

Data from R&D providers in each sectoral survey is summarised in Table 23. Each column represents the total R&D provided by that sector. Reading across the rows it is possible to estimate the total R&D funded by each sector. This will differ from the estimates obtained by using each sector's provider and funder data in isolation, as was done in the earlier sections.

Table 23. Gross expenditure on R&D carried out in, or funded by NZ, 1995/96

Source of funds	Sector of Performance ($000)							
	Done by Business	Done by Govt.	Done by Uni.	Total Done in NZ (GERD)	% of GDP NZ	% of GDP 6 ref.	Done Overseas	Done in NZ or funded by NZ
Funded by Business	207,977	65,575	25,638	299,190	0.33	1.03	10,948	310,138
Government	2,253	81,523	40,347	370,657			1,241	371,898
FRST	14,236	218,806	13,492					
General University Funds (GUF)			96,046	96,046				106,417
Total Funded by Govt. (includes GUF)	16,489	300,329	149,885	466,703	0.52	0.71		
University (own funds)		676	74,135	74,811				74,811
PNP	2,070	1,936	10,441	14,447				14,447
Overseas Funds	13,778	7,134	13,414	34,326				34,326
Total other funds	15,848	9,746	97,990	123,584	0.14	0.15		
Total	240,314	375,650	273,513	889,477	0.99	1.89	12,189	912,037
% GDP	0.27	0.42	0.30	0.99				
OECD 6 ref. countries	1.13	0.30	0.43	1.89				
% of GERD	27	42	31	100				
OECD 6 ref. countries[2]	60	16	23					

GDP in 1995 was $89,968 million

PNP: private non-profit

Thus, from this table it is estimated that the business enterprise sector spent $299 million on R&D carried out in New Zealand, the government sector spent $467 million (including GUF), and the universities spent $75 million of their own funds. Of the total of $889 million spent on research carried out in New Zealand, $34.3 million was paid for with funds from overseas and a further $14.4 million with private non-profit funds. A further $12.2 million was spent on research carried out overseas.

4.5 TYPE OF R&D EXPENDITURE, ALL SECTORS

Government agencies were asked to indicate how they spent their funds on R&D. The results are contrasted with those from business enterprise and universities in Table 24.

Wages and salaries consumed 46.7% of the $375.6 million allocated to R&D in the government sector, compared with 49.8% in the business sector. Other current expenditure accounted for 40% in the government sector and 39.7% in business. Capital expenditure was 12.5%, compared with 10.3% in the business sector. In these three areas, the proportion of expenditure allocated by universities was 53.7%, 38.3% and 8.1%, respectively.

Table 24. Type of R&D expenditure, all sectors, 1995/96

Sector / Type of Expenditure	Business ($ million)	Business (%)	Government ($ million)	Government (%)	University ($ million)	University (%)
Wages & Salaries	119.7	49.8	175.3	46.7	146.8	53.7
Redundancies	0.4	0.2	3.6	1.0	n.p.	
Other current	95.4	39.7	149.8	39.9	104.7	38.3
Capital - land & buildings	4.5	1.9	11.9	3.2	n.p.	
Capital - Plant, machinery, etc	20.2	8.4	35.0	9.3	22.1	8.1
Total	240.3	100.0	375.6	100.0	273.5	100.0

n.p. = not available separately (included in following row)

Table 25. Intramural R&D, all sectors, by output class, 1995/96

Output areas	($000) Business	Govt.	Uni.	Total	%
01 Sheep (meat)	233	1,708		1,941	
01 Sheep (wool)	1,057	2,602		3,659	
01 Sheep (general)	297	14,630	1,908	16,834	
02 Beef Production	{6,501}	{8,764}	730	{18,020}	
03 Dairy Production	{ }	{ }	2,026	{ }	
04 Alternative Animal Species	563	6,966	2,812	10,341	
05 Generic Animal Research	1,542	16,395	1,442	19,379	
06 Forage Plants	4,583	32,400	1,655	38,638	
07 Horticulture	3,817	38,907	2,355	45,079	
08 Arable Crops and other Plants	3,466	16,154	1,127	20,747	
09 Plantation Forestry	8,319	19,658	2,812	30,789	
10 Fisheries	1,712	24,541	1,297	27,549	
% of total, primary production R&D	14	78	8	232,978	26
11 Meat Processing	14,242	2,687	751	17,681	
12 Dairy Processing	37,303	1,082	1,759	40,145	
13 Other Food Processing	7,739	15,937	1,661	25,337	
14 Fibre , Textile & Skin Processing	23,508	n.p.	n.p.	26,499	
15 Wood & Paper Processing	6,839	15,577	1,705	24,121	
% of total, primary products processing R&D	67	27	6	133,782	15
16 Materials & Industrial Processing	6,621	13,718	4,309	24,648	
17 Engineering	26,370	4,047	7,245	37,662	
18 Electronic & Instruments	22,673	7,775	7,821	38,270	
% of total, materials, engineering R&D	55	25	19	100,579	11
19 Construction	8,641	{2,571}	2,152	{19,745}	
20 Commercial & Trade	2,707	{ }	3,673	{ }	
21 Energy	4,796	5,482	3,454	13,732	
22 Transport Services	2,906	1,579	750	5,236	
23 Information & Communications	17,963	1,671	5,835	25,469	
24 Urban & Rural Planning	380	874	2,929	4,184	
% of total, infrastructure R&D	55	18	27	68,364	8
25 History, Society & Culture	212	4,587	14,793	19,592	
26 Relationships & Wellbeing	624	3,961	10,153	14,738	
27 Political & Economic Relationships	1,528	3,819	15,421	20,768	
28 Education, Knowledge & Training	396	2,338	15,419	18,153	
% of total, social sciences R&D	4	20	76	73,250	8
29 Environmental Protection	4,441	14,741	4,143	23,325	
30 Geological Structure & Process	627	13,855	5,158	19,639	
31 Land use, Flora & Fauna	174	16,910	3,691	20,775	
32 Marine & Fresh Waters	928	30,808	4,110	35,847	
33 Climate & Atmosphere	541	14,905	2,299	17,746	
34 Space	n.p.	{2,962}	291	{4,844}	
35 Antarctica	n.p.	{ }	1,518	{ }	
% of total, environment & resources R&D	5	75	16	122,176	14
36 Fundamental Knowledge	n.p.	300	53,314	53,616	
37 Health	15,958	2,665	78,913	97,536	
38 Defence	n.p.	{7,083}	{80}	{7,201}	
Other	n.p.	{ }	{ }	{ }	
% of total, fundamental, health & defence R&D	10	6	84	158,353	18
TOTAL	240,315	375,649	273,514	889,478	100

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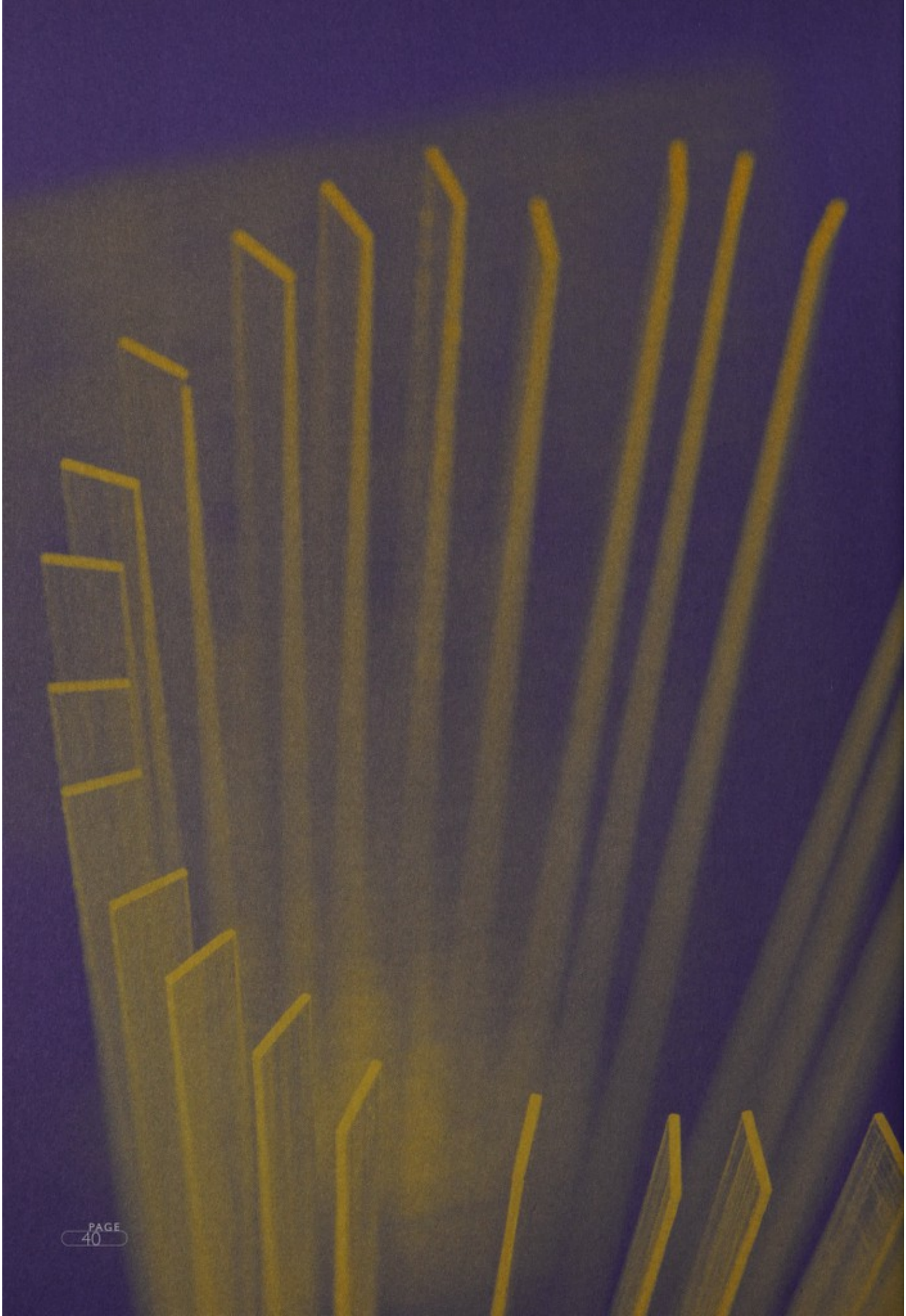
n.p. = Not published for reasons for confidentiality



5 PERSONNEL

5.1 KEY RESULTS

- In 1995/96 the R&D full-time equivalents (FTEs) of all personnel engaged in research (researchers, technicians and support staff) in the business sector numbered 2,828. This included 683 R&D FTEs who were engaged in research associations and producer boards.
- A total of 3,984 R&D FTEs were employed in CRIs and government organisations. CRIs account for 92% of government R&D FTEs.
- Of the total FTEs in R&D in the business and government sectors, 6,812 (an increase of 57 over 1993/94), 67% were male and 33% female. The percent of female employees increased by 4 percentage points from 1993/94.

5.2 R&D PERSONNEL

Business enterprises and government agencies were asked to provide information on the total number of R&D personnel by full time equivalents (FTE), as well as breakdowns by gender in the 1995/96 survey. R&D FTE gives a much better estimate of the R&D effort than a head-count of personnel. This is the reason that statistical data is collected in R&D FTE for the OECD.

Research associations and producer boards are included in the business sector.

The total of FTE R&D staff in government and business sectors came to 6,812. Of the total, 4,559 (67%) were male and 2,253 (33%) were female.

Women make up 27.1% of R&D staff in the business sector, 36.7% in CRIs, and 44.2% in other Government departments. These figures increased 2.9, 3.3 and 5.8 percentage point respectively compared with the results in 1993/94.

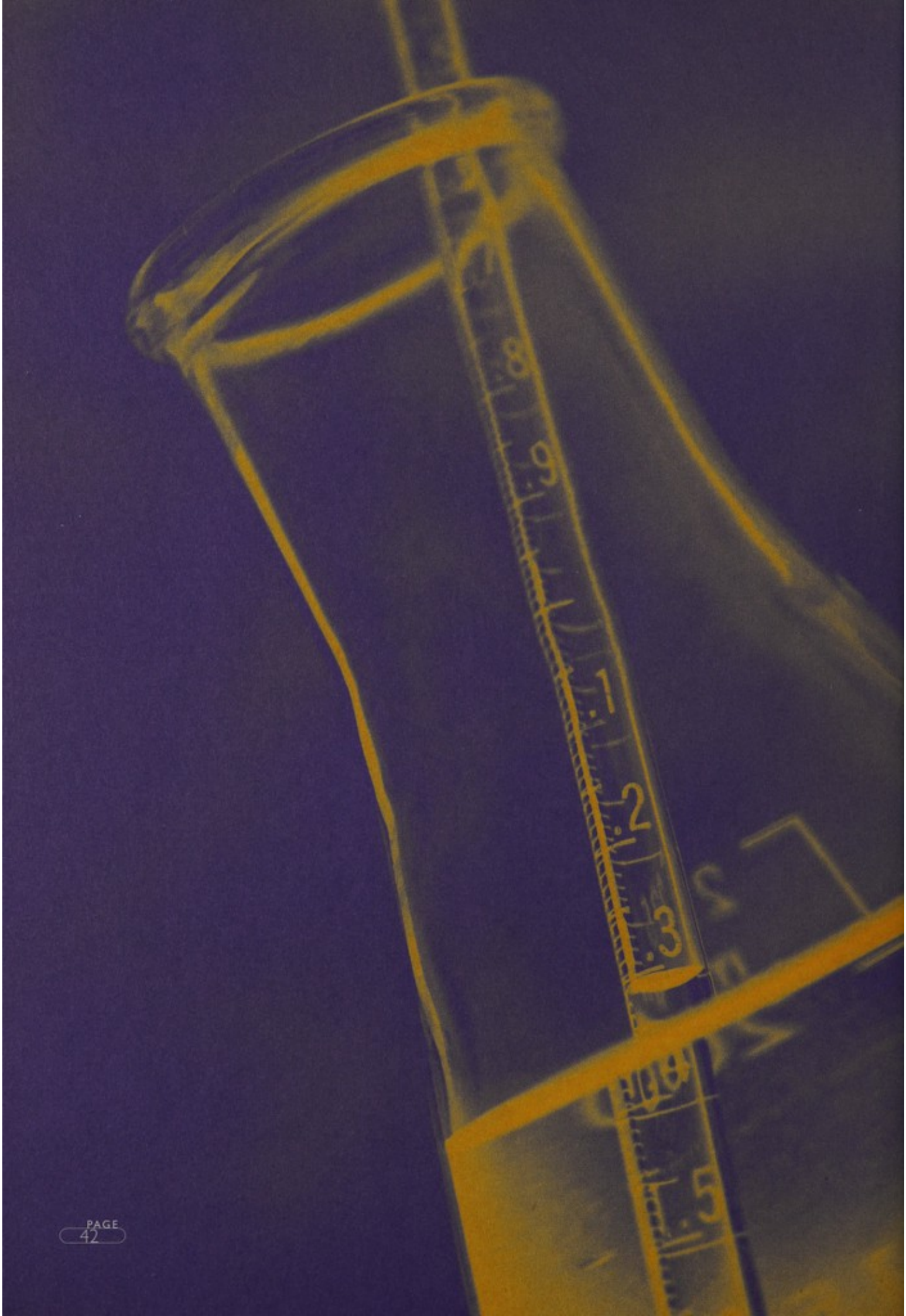
Women, excluding those employed in universities, account for 20.3% of researchers, 37.2% of technicians, and 54.4% of support staff. The highest proportion of women researchers are found in other Government departments with 40%. The lowest proportion of women engaged in R&D is in business and the CRIs with 17% and 21% respectively. The highest proportion of women technicians are found in CRIs (39%) and the lowest in business (33%). The highest proportion of women support staff are found in other Government departments (68%); the lowest proportion in the business sector (51%).

There are 0.52 technical staff for each researcher in business. This may be compared to an Australian figure of 0.4 for the business sector[1]. In CRIs, the figure is 1.09 technicians per researcher, in other Government departments 0.45.

Table 26. Full-time equivalent R&D personnel, by occupation, 1995/96

Occupation	*Gender*	*Business R&D FTE*	*CRI's R&D FTE*	*Government R&D FTE*	*Total R&D FTE*
Researchers	*M*	*1,306*	*1,035*	*112*	*2,453*
	F	*274*	*276*	*74*	*624*
	Total	*1,580*	*1,311*	*187*	*3,077*
Technicians	*M*	*549*	*869*	*53*	*1,470*
	F	*274*	*565*	*31*	*870*
	Total	*823*	*1,434*	*84*	*2,341*
Support Staff	*M*	*207*	*410*	*19*	*636*
	F	*218*	*499*	*41*	*758*
	Total	*425*	*909*	*59*	*1,394*
All	*M*	*2,062*	*2,313*	*184*	*4,559*
	F	*766*	*1,341*	*146*	*2,253*
	Total	*2,828*	*3,654*	*330*	*6,812*
Total Government				*3,984*	

University data on personnel were not surveyed in 1996



6 TECHNOLOGICAL BALANCE OF PAYMENTS

6.1 BUSINESS AND GOVERNMENT SECTORS

Government and business sector payments and receipts abroad for technical know-how are shown in Table 27.

In 1995/96, the business sector received a net amount of $19.5 million, a slight increase from the figures in 1993/94. Net receipts for government have decreased from $3.5 million in 1993/94 to $1.2 million in deficit in 1995/96. The total net receipts have decreased from $22.8 million in 1992/93 to $18.3 million in 1995/96.

The national balance of payments for international transactions relating to trade in technical know-how for the business enterprise and government sectors was a surplus of $18.3 million (compared to $22.8 million for 1993/94).

Technical know-how includes patents, licences and technical and engineering services that increase the existing technical knowledge in a business. For a full definition refer to the Introduction.

Table 27. Technological balance of payments

$millions

	1995/96		*1993/94*	
	Sale-purchases	*Net receipts*	*Sale-purchases*	*Net receipts*
Business	*29.1-9.6*	*19.5*	*32.1-12.8*	*19.3*
Government	*1.6-2.8*	*-1.2*	*4.0-0.5*	*3.5*
Total net receipts		*18.3*		*22.8*

ANNEX 1

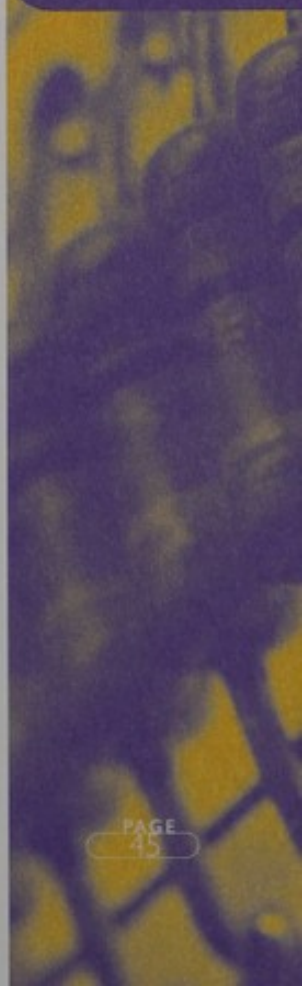
GOVERNMENT SECTOR ORGANISATIONS UNDERTAKING AND FUNDING R&D, 1995/96

A. Government sector organisations undertaking R&D

Accident Rehabilitation and Compensation Insurance Corporation
Auckland Gas Co Ltd
Bay of Plenty Regional Council
Canterbury Health Ltd
Carter Observatory Board
City Forests Ltd
Defence Scientific Establishment
Department of Internal Affairs
Department of Social Welfare
Eastland Energy Ltd
Health & Disability Commissioner
Horticulture & Food Research Institute of NZ Ltd
Industrial Research Ltd
Institute of Environmental Science & Research Ltd
Institute of Geological & Nuclear Sciences Ltd
Institute of Social Research & Development Ltd
Landcare Research NZ Ltd
Land Transport Safety Authority
Maori Language Commission
Museum of New Zealand Te Papa Tongarewa
National Institute of Water & Atmospheric Research Ltd
NZ Forest Research Institute Ltd
NZ Institute for Crop & Food Research Ltd
NZ Pastoral Agriculture Institute Ltd
Southpower Ltd

B. Government sector organisations funding R&D

Alcohol Advisory Council of New Zealand
Clifton Wool Scour Ltd
Coal Research Association of (NZ) Inc
Earthquake Commission
Foundation for Research Science and Technology
Health Research Council of NZ
MAF Policy
Marlborough District Council
NZ Fish & Game Council
NZ Lottery Grants Board
NZ Racing Industry Board
Selwyn Plantation Board Ltd
Taranaki Business Development Board
The Agricultural & Marketing Research & Development Trust
The Royal Society of NZ
Top Energy Ltd
Transit NZ
Wanganui Business Development Board
Wellington Business Development Board



ANNEX 2

SCIENCE OUTPUT CLASSES

Agriculture, horticulture, forestry and fisheries

New and improved

1 *Sheep and sheep production systems*
2 *Beef animals and beef production systems*
3 *Dairy animals and dairy production systems*
4 *Other animal species, animal products and primary production systems*
5 *Generic animal and animal production information bases, systems and products*
6 *Forage plants and forage management practices*
7 *Horticultural crops (including vegetables) and management practices*
8 *Arable crops, ornamental, amenity, shelter, conservation and other plants and management practices*
9 *Trees and plantation management systems*
10 *Fish harvesting and production systems for marine and freshwater fisheries*

Secondary industries

New and improved

11 *Meat processes, storage techniques and products*
12 *Dairy processes, storage techniques and products*
13 *Fruit, crops and other food and beverage processes, storage techniques and products*
14 *Fibres and skin processes and products*
15 *Wood and paper processes and products*
16 *Materials, industrial processes and products (includes mineral processing)*
17 *Engineering processes, systems and products (including transport engineering)*
18 *Computing and electronic, communication and instrumentation processes, systems and products (hardware).*
19 *Construction processes, systems and products (including roading construction)*

Commercial and trade services

New and improved

20 *Information bases, processes and systems for commercial and trade services*

Energy

New and improved

21 *Information bases for prospecting, production and use of all energy sources*

Transport

New and improved

22 *Information bases, processes and systems for transport*

Information processing and communications services

New and improved

23 *Information processing software, software and services for electronic communication, media transmission and data interchange*

Urban and rural planning

New and improved

24 Urban and rural planning information bases, processes and systems

Social development and services

Information bases on

25 New Zealand history, society, culture and Te Ao Maori

26 Social and personal development, relationships and wellbeing

27 Political, economic and international relationships

28 Knowledge, education and training

Environment

New and improved

29 Protection and management technologies for the environment

Exploration and assessment of the earth

Information bases on

30 Geological structures and resources, and solid earth processes (including mineral prospecting -see output 16 for mineral processing)

31 The properties, distribution, and potential uses of types of land and land based flora and flora

32 Marine and fresh waters, their substrate, flora and fauna

33 Climate and the atmosphere

34 Properties, uses and technologies for space

35 The natural environment of Antarctica

General advancement of knowledge

Information bases on

36 Fundamental information in the natural sciences, engineering, social sciences and humanities (where no end use has been identified)

Health

New and improved

37 Information bases, systems and products in health

Defence

New and improved

38 Information bases, systems and technologies for defence

S&T Education and Services

39 Further education/training of those already active in the science community

40 Provision of scientific and technological services, e.g. museums, zoological and botanical gardens; publishing and primary measurement standards.

ANNEX 3

NEW ZEALAND STANDARD INDUSTRIAL CLASSIFICATION

(Grouped for the purposes of R&D statistics)

Industry Groups	Component Industries	NZSIC codes
Agriculture	Agriculture, Forestry, Fishing	11,12,13
Mining	Mining and Quarrying	2
Basic Metals	Ferrous Metals	371
	Non-ferrous Metals	372
	Fabricated Metal Products	381
Chemical Group	Chemicals (industrial and other chemicals)	351, 352 except 3522
	Drugs	3522
	Petroleum Refining	353, 354
Chemical-linked	Food, Drink and Tobacco	31
	Textiles, Footwear and Leather	32
	Rubber and Plastic Products	355, 356
Electrical Group	Electrical Machinery	383 except 3832
	Electronic Equipment and Components	3832
Machinery	Instruments	385
	Office and Computing Machinery	3825
	Machinery n.e.c	383 except 3825
Other Manufacturing	Stone, Clay, Glass	36
	Paper and Printing	34
	Wood, Cork and Furniture	33
	Other Manufacturing	39
Transport Equipment	Motor Vehicles	3843
	Ships	3841
	Other Transport	3842, 3844, 3849
Infrastructure Services	Utilities (electricity, gas and water)	4
	Construction	5
	Wholesalers (industrial machinery, electrical and professional equipment)	61
	Transport, Storage	71
	Communication	72
Financial, Software Services	Business and Financial Service (trading banks)	8 except 8323, 8324
	Computer Bureaux and Consultancy, Software Development	8323
Engineering, scientific services	Community, Social and Personal Service including Research and Scientific Institutes, Charities, Local Authorities	9
	Engineering, Architectural and Technical Services	8324

n.e.c = not elsewhere classified

Note: Research Associations and Producer Boards have been allocated an industry code which matches the industry which they serve, where this is known.

REFERENCES

1. Ministry of Research, Science and Technology, 1991, "New Zealand Research and Development Statistics: Business Enterprise Sector, 1989/90" Wellington. Publication No.1.
2. Ministry of Research, Science and Technology, 1992, "New Zealand Research and Development Statistics: Government Sector, 1989/90" Wellington. Publication No.3.
3. Ministry of Research Science and Technology, 1992, "A Profile of Crown-funded R&D in New Zealand, 1991/92: A bench-mark analysis of Crown-funded scientific and technological research conducted in New Zealand during 1991/92" Wellington. Publication No.5.
4. Bollard A., Bergquist P., Clarke R., 1992, "The Study of University Research-Report of the Review Team" (unpublished report for the Ministry of Research Science and Technology).
5. Ministerial Science Task Group, 1991, "Crown Research Institutes: Research Companies for New Zealand", Thames Publications.
6. OECD, 1993, "The Measurement of Scientific and Technical Activities" Paris.("Frascati Manual")
7. Science and Technology Advisory Committee, 1988, "Science and Technology Statement 1988" Wellington.
8. Department of Statistics, 1987, "New Zealand Standard Industrial Classification, 1987 Edition".
9. Edwards F., 1992, "Research and Development Spending: A Comparison Between New Zealand and Other OECD Countries". Ministry of Research, Science and Technology, Wellington. Report No. 5.
10. Ministry of Research, Science and Technology, 1992, "New Zealand Research and Development Statistics: All Sectors, 1990/91" Wellington. Publication No.7.
11. Ministry of Research, Science and Technology, 1994, "New Zealand Research and Experimental Statistics: All Sectors, 1991/92" Wellington. Publication No.12.
12. OECD, 1994 (Part 2), "Main Science and Technology Indicators" Paris.
13. Ministry of Research, Science and Technology, 1995, "New Zealand Research and Experimental Developmental Statistics: All Sectors, 1992/93" Wellington. Publication No.13.
14. Department of Industry, Science & Technology, 1996, "Australian Business Innovation - A Strategic Analysis" Canberra. Commonwealth of Australia.