New Zealand research and experimental development statistics : government sector, 1989/90 / Ministry of Research, Science and Technology.

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Government Sector, 1989/90.

Ministry of Research, Science and Technology

Te Manatu Putaiao

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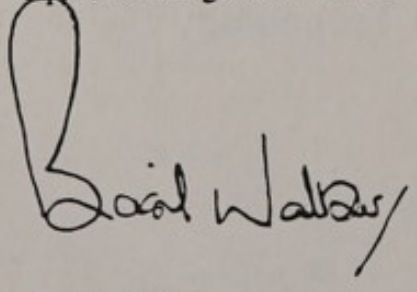
Publication No 3

April 1992
ISSN 1170-9618

Published by the Ministry of Research, Science and Technology
P O Box 5336
Wellington
New Zealand
Phone (04) 4726-400; Fax (04) 4711-284

This document is the report of the survey of government sector R&D carried out by the Ministry of Research, Science and Technology. The statistics were collected by Pamela Walker, and the text compiled by Barbara Bibby.

Approved for general release



Basil Walker
Chief Executive

FOREWORD

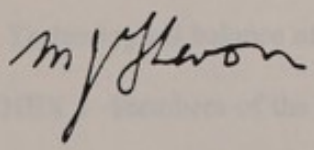
This survey of research and development in the government sector is the second of a series of R&D surveys to be undertaken by the Ministry of Research, Science and Technology. It was carried out with the approval of the Department of Statistics and should provide valuable information to policy makers in government and business.

The process for carrying out this survey was developed with the valuable assistance of an advisory group whose members were drawn from the key science departments. I would like to thank the advisory group for their informed comment and attention to detail which have helped to ensure the acceptance of and good response to the survey.

The government departments were generally very willing to provide the information and to participate in the survey. Any survey of R&D is likely to encounter definitional problems in its early stages, and some departments had difficulty in providing data according to the OECD definitions. These problems will become easier to resolve as the participants start to record the information in the desired format.

The tabulations presented here are designed to make information available as quickly as possible. Further analysis of the information, especially in relation to economic indicators, will follow when data for the next year become available.

R&D statistics become more valuable for policy development and other purposes when the surveys have been repeated for a number of years, and trends in expenditure and human resources become evident. The Ministry is at present undertaking a survey of government sector R&D for the 1990/91 financial year, as well as similar surveys for the business enterprise and higher education sectors.



Margriet Theron
Manager, Science Review
Ministry of Research, Science and Technology

CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

This report is the second in a series on R&D expenditure in New Zealand. The first report, published in 1991, covered research undertaken by the business enterprise sector. This report gives the results of a survey of R&D undertaken and funded by the government sector.

The total expenditure on R&D carried out in the government sector was $290 million while that in the business enterprise sector was $200 million. These represent 0.41 percent and 0.29 percent of GDP, respectively.

It is striking that about half of the R&D expenditure in the government sector in 1989/90 was aimed at 'Primary production'. This involved research into new and improved production and management systems related to New Zealand's traditional role as supplier of primary products in agriculture, horticulture, forestry and fisheries. By contrast, in the business enterprise sector, R&D in the area of primary production comprised only 7 percent of the total. In absolute terms, ten times more was spent in this area in the government sector ($142 million) than in the business enterprise sector ($14 million).

Research on 'New and improved horticultural crops (including vegetables) and management practices' accounted for about one-quarter of the primary production R&D carried out by the government sector. It was followed by R&D related to forage plants (15 percent), fish (13 percent) and sheep (12 percent).

About a quarter of the R&D carried out in the government sector was in the area of 'Environment, exploration and assessment of the Earth'. This involved research into New Zealand's environment and natural resources. By contrast, this kind of research comprised only 3 percent of the R&D of the business enterprise sector. 'Geological structures' and 'Marine and fresh waters' respectively, received about equal funding and together comprise nearly half the government expenditure in this category (48 percent). R&D into different types of land and land-based flora and fauna, was the next most important (21 percent).

Two areas which were major contributors to the R&D of the business enterprise sector, each comprising about one-third of the total carried out, are less important in the government sector's R&D. These areas are 'Primary products and processing' and 'Materials, engineering and telecommunications'. The two areas taken together can be described as R&D leading to new and improved processes and products in New Zealand's secondary industries. Such research accounted for two-thirds of the funding in the business enterprise sector but only 15 percent of the funding in the government sector.

The area of 'Infrastructure and services', was also more important in the business enterprise sector than in the government sector, with 21 and 2 percent of the total, respectively.

These different distributions in the R&D carried out by the government sector and the business enterprise sector indicate that the former concentrated on New Zealand's primary industries, the environment and natural resources while the latter was focused on secondary industries, infrastructure and services. This is satisfying in the sense that while the overall level of R&D funding is low by OECD standards, R&D in the two sectors would appear to be complementary. Expenditure on research on social development and services, and on defence, is low by OECD comparisons, in both the government and business enterprise sectors.

Eleven percent of the funding for Government research was obtained from private sector enterprises for research undertaken on contract.

The total number of full-time equivalent personnel employed in R&D in the government sector came to 4,180, which can be compared with 2,826 in the business enterprise sector.

The percentage of R&D personnel with PhDs in science or engineering was higher in the government sector than in the business enterprise sector, being 17 percent and 7 percent respectively of the total staff numbers.

SURVEY RESULTS

1 Background

A previous publication[1], which will be referred to throughout this paper as the 'Business Enterprise Survey', was the first comprehensive statistical survey of private sector research and development (R&D) in New Zealand. This publication extends the survey to the government sector, excluding the higher education sector which will be surveyed in a third parallel study.

These surveys aim to collect comprehensive R&D statistics from the three sectors for the first time in New Zealand, so that they can be combined to generate a full picture of R&D in New Zealand for the period 1989/90. They also aim to establish a methodology for the survey process, which will then be repeated at regular intervals for release to government, business and other users in the community.

The statistics will be used in the development of science policy in areas such as the setting of research priorities, government funding levels, science education, and innovation encouragement schemes.

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

The present survey included the four government departments that undertake public good research, as well as a large number of departments and Crown agencies that undertake operational research to support their own outputs. The government science departments are: the Department of Scientific and Industrial Research, the Ministry of Agriculture and Fisheries, the Ministry of Forestry and the Meteorological Service.

In line with OECD methodology, statistical information is gathered from the providers rather than the funders of research. In 1989/90, the main sources of funds for research in the government sector were departmental appropriation of funds by Parliament, and commercial contracts carried out for the business enterprise sector, other government departments, and other clients.

Only research and development activities, as defined by the OECD, are included in the survey. Consulting work is excluded. Definitions of research and development are given in section 5.

The desirability of government research institutions undertaking 'commercial' work has been stressed in recent years, and the growth of such work demonstrates the usefulness of R&D in New Zealand. At the conclusion of the three surveys, research carried out within the government and higher education sectors for commercial and other clients will be added to the R&D performed by the business enterprise sector to give the full picture of R&D funded by the business enterprise sector in New Zealand.

Similar correlations will be made across the three surveys, to evaluate the total spending by the government sector on R&D in New Zealand.

2 A historical note

The past six or seven years have been a time of considerable change in the nature of government-funded research in New Zealand. The processes which had occurred up to, and including, the time of this survey (1989/90) included:

- definition of the concept of 'public-good' scientific research and of desirable science outcomes resulting from such research;
- definition of a set of forty science 'output classes', 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;

- required presentation by each research organisation of a corporate plan or statement of intent listing the year's research objectives and an annual report to Parliament describing their achievement; and

- continued encouragement for government research organisations to undertake 'commercial' work funded from non-government sources.

In the past, collection of R&D data in New Zealand has not occurred on a systematic or regular basis. Previous information on R&D in the government sector was collected by the National Research Advisory Council and by the Science and Technology Advisory Committee (1988).

The latter body's report[2] on the New Zealand science scene recommended the establishment of a contestable bidding system for 'public good' research, to be administered by the Foundation for Research, Science and Technology. This would replace the direct allocation of funds by Parliament to science departments. The period of this survey, 1989/90, was the last year in which the government science departments received their Crown funding through direct appropriation. The contestable bidding system was emplaced early in 1990 and came partially into effect during the financial year 1990/91 and fully in 1991/92.

3 Role of the Ministry

The Ministry of Research, Science and Technology has the following principal functions:

1. To advise the Minister on national science and technology policy.

2. To identify national priorities for government funding of research and technology.

3. To facilitate and to publish science reviews, to collect data on all forms of national R&D activity and to fulfil international obligations to provide data on R&D.

4. To maintain international science agreements and scientific co-operation.

In relation to this survey, the function of the Ministry of Research, Science and Technology is to arrange for the collection of data on national inputs into, and outputs from, R&D, including fulfilling international obligations to provide data on national science and technology activity to the OECD and other bodies.

This survey was conducted with the approval of the New Zealand Department of Statistics.

4 Survey methodology

An Advisory Group with representatives from government science departments was set up to advise on the survey questionnaire and methodology. The membership is detailed in Annex 1 to this report.

The 1989/90 statistics presented in this publication have been compiled from data collected from government departments by a Survey of Research and Experimental Development for the year ended June 1990. Questionnaires were sent to 100 government agencies.

The survey included all government organisations and agencies which were identified as possibly engaged in research.

Most of the tables in this report represent expenditure on R&D *carried out* by the government sector, which is called 'Government R&D' or 'GOVERD' in OECD tabulations. Total *funding* of R&D by the government sector includes that for R&D carried out in other sectors (private, universities, overseas).

The response rate for the survey was 95 percent. All agencies expected to engage in research provided a response, and 42 responses were positive. The Health Research Council and Area Health Board responses were removed when it was found that most of their research is carried out in medical schools and will therefore be included in the higher

education sector survey.

A problem was encountered because of the OECD's requirement that 'consulting' should not be included in R&D. Some scaling of funding and of personnel numbers was undertaken in this survey in order to allow for the fact that some of the R&D undertaken by the DSIR did include consulting work. For the 1990/91, data will be sought from each DSIR division separately, to improve reliability.

5 Definitions used in the survey

The survey used the OECD definition of R&D:

'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')[3].

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 activity *funded* by an organisation but *carried out* by others.

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; and the proportion of expenditure on general services and overheads which is attributable to R&D activity.

Human resources devoted to R&D measures 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 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 eg 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.

6 Scope of the survey

Questionnaires were sent to 100 government organisations and agencies which were identified as possibly engaged in research. Ninety five replies were received, of which 42 were from agencies who stated that they were carrying out or funding R&D, or exporting or importing technical know-how. The organisations are listed in Annex 2.

7 Intramural R&D, by science output class

7.1 In summary

For consistency, and in order to compare the results of this survey with those of the Business Enterprise Survey[1] and future surveys, the information presented here is grouped according to presently defined science output classes (from 1991 onwards, see Annex 3) rather than those which were current in 1989/90. To aid the comparison, each figure contains an inset which presents the results obtained in the Business Enterprise Survey[1] of R&D for the same period.

The total spending on intramural government R&D is presented in Figure 1 and Table 1. The output classes defined in Annex 3 have been grouped into broader categories, as shown in Table 1.

The total expenditure on R&D carried out in the government sector was about $290 M while that in the business enterprise sector was about $200 M. These represent 0.41 percent and 0.29 percent of GDP, respectively.

It is striking that about half (49 percent) of the R&D expenditure in the government sector in 1989/90 was aimed at 'Primary production'. This involved research in output classes 1 to 10, namely research into new and improved production and management systems related to New Zealand's traditional role as supplier of primary products in agriculture, horticulture, forestry and fisheries. By contrast, in the business enterprise sector, R&D in the area of primary production comprised only 7 percent of the total. In absolute terms, ten times more was spent in this area in the government sector ($142 M) than in the business enterprise sector ($14 M).

About a quarter (26 percent) of the R&D carried out in the government sector was in the area of 'Environment, exploration and assessment of the Earth', namely in output classes 29 to 35 as listed in Annex 3 and summarised in Table 1. This involved research into New Zealand's environment and natural resources. By contrast, this kind of research comprised only 3 percent of the R&D of the Business Enterprise sector.

Two areas which were major contributors to the R&D of the business enterprise sector, each comprising about one-third of the total carried out, are seen in Table 1 to be less important in the government sector's R&D. These areas are 'Primary products and processing' (output classes 11 to 15) and 'Materials, engineering and telecommunications' (output classes 16 to 18). The two areas taken together (i.e. output classes 11 to 18) can be described as R&D leading to new and improved processes and products in New Zealand's secondary industries. Such research accounted for two-thirds of the funding in the business enterprise sector but only 15 percent of the funding in the government sector.

The area of 'Infrastructure and services', (output classes 19 to 24) was also more important in the business enterprise sector than in the government sector, with 21 and 2 percent of the total, respectively.

Figure 1. TOTAL INTRAMURAL GOVERNMENT SECTOR R&D, BY SCIENCE OUTPUT CLASS, 1989/90

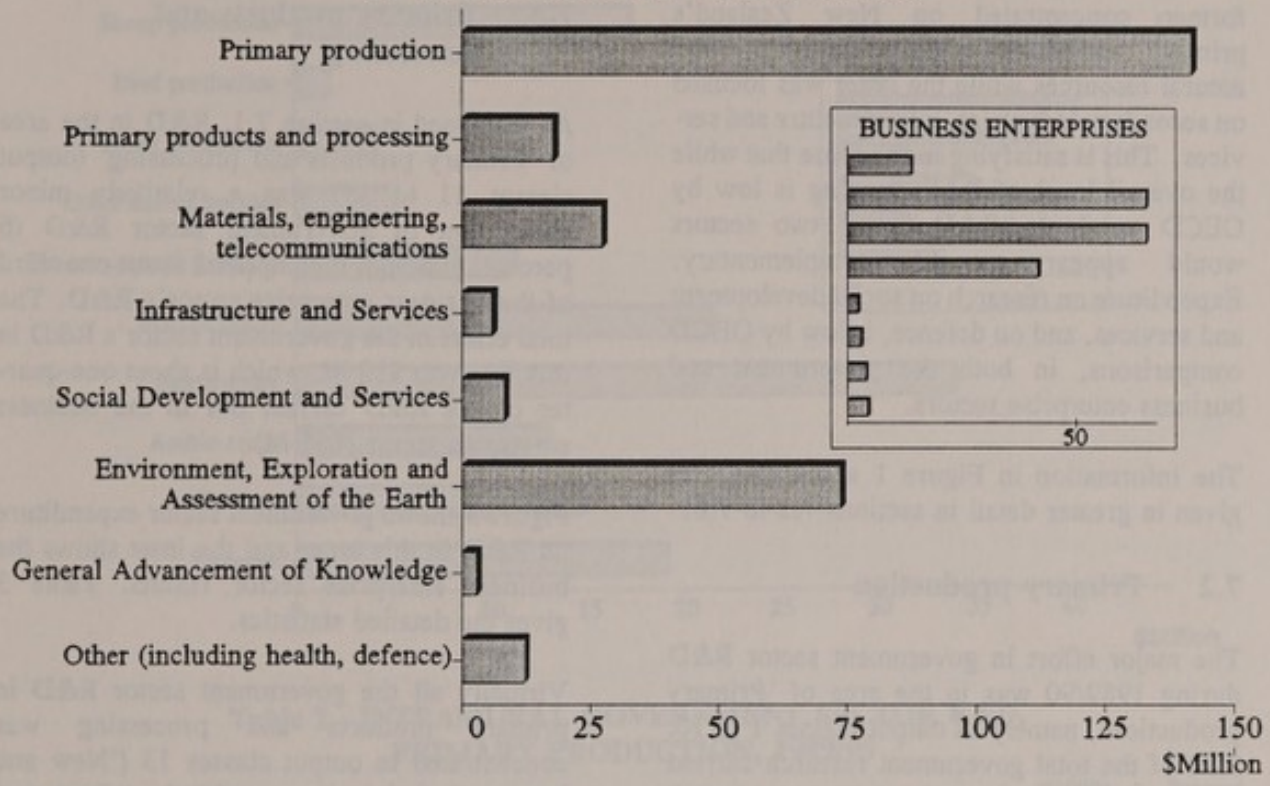


Table 1. TOTAL INTRAMURAL GOVERNMENT SECTOR R&D, BY SCIENCE OUTPUT CLASS, 1989/90

Output Class	Title		($'000)	Percent
1-10	Primary production		141,928	48.9
11-15	Primary products and processing		17,917	6.2
16-18	Materials, engineering, telecommunications		26,746	9.2
19-24	Infrastructure and services		6,476	2.2
25-28	Social development and services		8,279	2.9
29-35	Environment, exploration and assessment of the earth		73,719	25.5
	29 Environmental protection	10,373		
	30 Geological structures	18,125		
	31 Land use, flora and fauna	16,393		
	32 Marine and fresh water	18,336		
	33 Climate and atmosphere	4,637		
	34 Space	0		
	35 Antarctica	5,855		
36	General advancement of knowledge		2,909	1.0
37	Health		879	0.3
38	Defence		6,525	2.2
39	Other		4,810	1.7
	Total		290,188	100.0

Note:The first four groups are expanded in figures 2 to 5. Columns will not always agree with totals shown due to rounding of individual estimates.

These different distributions in the R&D carried out by the government sector and the business enterprise sector indicate that the former concentrated on New Zealand's primary industries, the environment and natural resources while the latter was focused on secondary industries, infrastructure and services. This is satisfying in the sense that while the overall level of R&D funding is low by OECD standards, R&D in the two sectors would appear to be complementary. Expenditure on research on social development and services, and on defence, is low by OECD comparisons, in both the government and business enterprise sectors.

The information in Figure 1 and Table 1 is given in greater detail in sections 7.2 to 7.6.

7.2 Primary production

The major effort in government sector R&D during 1989/90 was in the area of 'Primary production', namely in output classes 1 to 10. Half of the total government research carried out was in this area, and in absolute terms it received ten times more funding than it did in the business enterprise sector ($140 M and $14 M respectively).

Figure 2 (with an inset showing the business enterprise sector results) and Table 2 break down this area into its ten component output classes. Eight of these are agricultural, with one each devoted to forestry and fishing.

Output class 7 ('New and improved horticultural crops, including vegetables, and management practices') accounted for about one-quarter (24 percent) of the primary production R&D carried out by the government sector. It was followed by R&D related to forage plants (15 percent), fish (13 percent) and sheep (12 percent).

The distribution of government sector R&D effort was in marked contrast with that in the business enterprise sector, as can be seen on Figure 2. Apart from the ten-fold difference in absolute funds spent, the distribution of interest was different. In particular, dairy production was only a minor field of interest in government sector R&D, but it was second only to sheep production in the business enterprise sector's R&D.

7.3 Primary products and processing

As discussed in section 7.1, R&D in the area of 'Primary products and processing' (output classes 11 to 15) was a relatively minor component of government sector R&D (6 percent) although it comprised about one-third of the business enterprise sector's R&D. The total effort in the government sector's R&D in this area was $18 M, which is about one-quarter of the R&D carried out in the business enterprise sector ($65 M).

Figure 3 shows government sector expenditure on R&D in this area, and the inset shows the business enterprise sector results. Table 3 gives the detailed statistics.

Virtually all the government sector R&D in primary products and 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 57 and 36 percent of the R&D effort respectively, a total of 93 percent. These two output classes together comprised less than a quarter (23 percent) of the business enterprise sector's R&D.

Output class 12 ('New and improved dairy processes, storage techniques and products') received only 0.4 percent of the government sector's R&D effort ($66 000) while it was the major component of the business enterprise sector's R&D, comprising 44 percent ($28 M) of the effort in this area.

Figure 2. INTRAMURAL GOVERNMENT SECTOR R&D, PRIMARY PRODUCTION, 1989/90

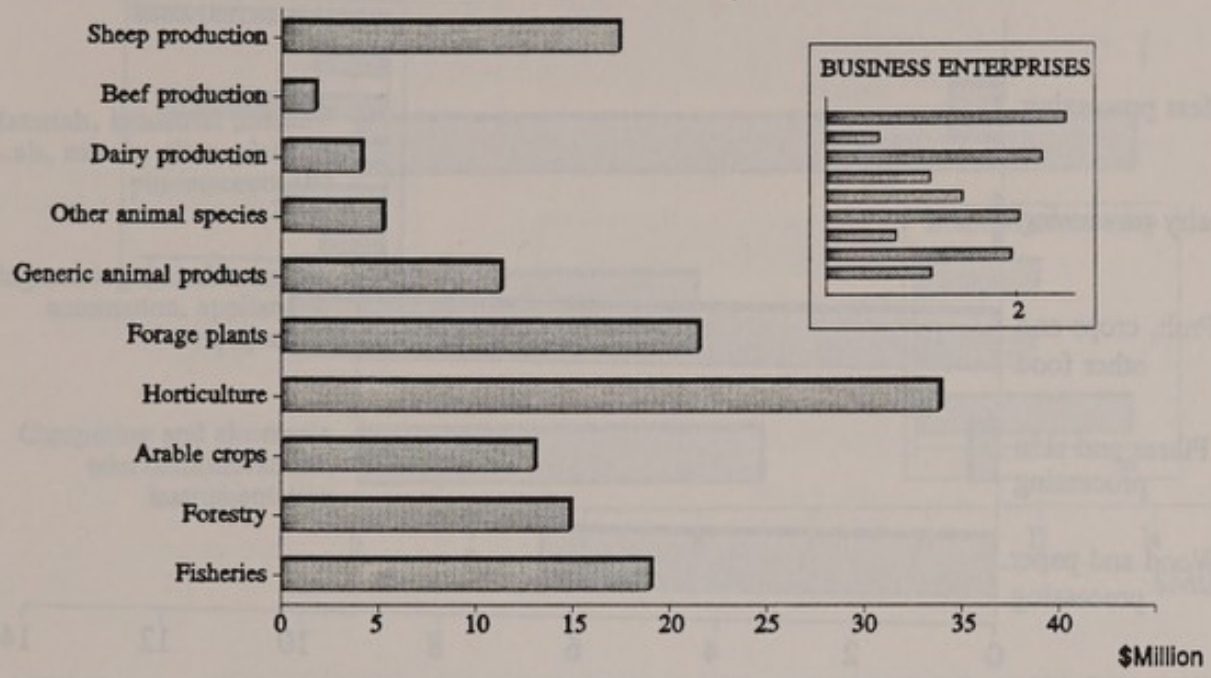


Table 2. INTRAMURAL GOVERNMENT SECTOR R&D, PRIMARY PRODUCTION, 1989/90

Output Class	Title	($'000)	Percent
1	Sheep and sheep production systems	17,375	12.2
2	Beef animals and beef production systems	1,731	1.2
3	Dairy animals and dairy production systems	4,120	2.9
4	Other animal species, animal products and primary production systems	5,206	3.7
5	Generic animal and animal production information bases, systems and products	11,282	7.9
6	Forage plants and forage management practices	21,499	15.1
7	Horticultural crops and management practices	33,886	23.9
8	Arable crops, ornamental, amenity, shelter, conservation and other plants and management practices	13,002	9.2
9	Trees and plantation management systems	14,847	10.5
10	Fish harvesting and production systems for marine and freshwater fisheries	18,981	13.4
	Total	141,928	100.0

7.4 Materials, engineering, computing and communications

Although R&D in the area of 'Materials, engineering and telecommunications' (output classes 16 to 18) accounted for one-third of the expenditure in the business enterprise sector ($65 M) it was of less importance in the government sector ($27 M, 9 percent of total funding).

Figure 4 shows government sector expenditure on R&D in this area, and the inset shows the business enterprise sector results. Table 4 gives the detailed statistics.

Output class 18 ('New and improved computing and electronic, communication and instru-

Figure 3. INTRAMURAL GOVERNMENT SECTOR R&D, PRIMARY PRODUCTS AND PROCESSING, 1989/90

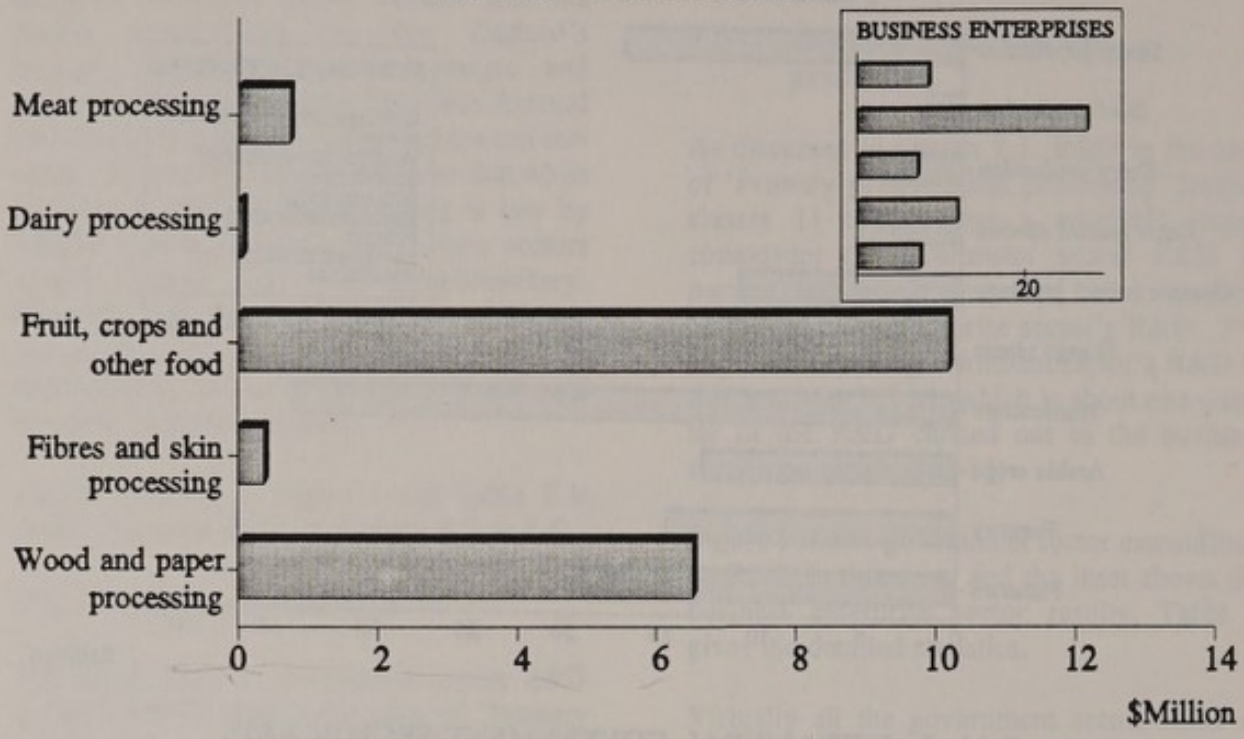


Table 3. INTRAMURAL GOVERNMENT SECTOR R&D, PRIMARY PRODUCTS AND PROCESSING, 1989/90

Output Class	Title	($'000)	Percent
11	Meat products and processing	741	4.1
12	Dairy products and processing	66	0.4
13	Fruit, crops and other food and beverage products and processing	10,192	56.9
14	Fibres and skin products and processing	382	2.1
15	Wood and paper products and processing	6,535	36.5
	Total	17,917	100.0

Note: Columns will not always agree with totals shown due to rounding of individual estimates.

mentation processes, systems and products i.e. computer hardware) was the class most heavily funded in the business enterprise sector ($31 M). In the government sector it was funded only to the extent of $7 M. However, it must be borne in mind that output class 18 describes only *directly* funded R&D in this field whereas related research is also funded *indirectly* by government in many other areas. This is because Information Technology (IT) is becoming such a basic tool that it is becoming 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 result in a large addition to the government sector's expenditure in output class 18.

Similar arguments apply to output 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 by far the largest area of business enterprise sector R&D in New Zealand, with a total expenditure of $52 M, or just more than a quarter 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 $8 M, or less than 3 percent of government sector R&D.

In the government sector, output class 16 ('New and improved materials, industrial processes and products') received about half the R&D funding within this area (51 percent).

Figure 4. INTRAMURAL GOVERNMENT SECTOR R&D, MATERIALS, ENGINEERING, COMPUTING AND COMMUNICATION, 1989/90

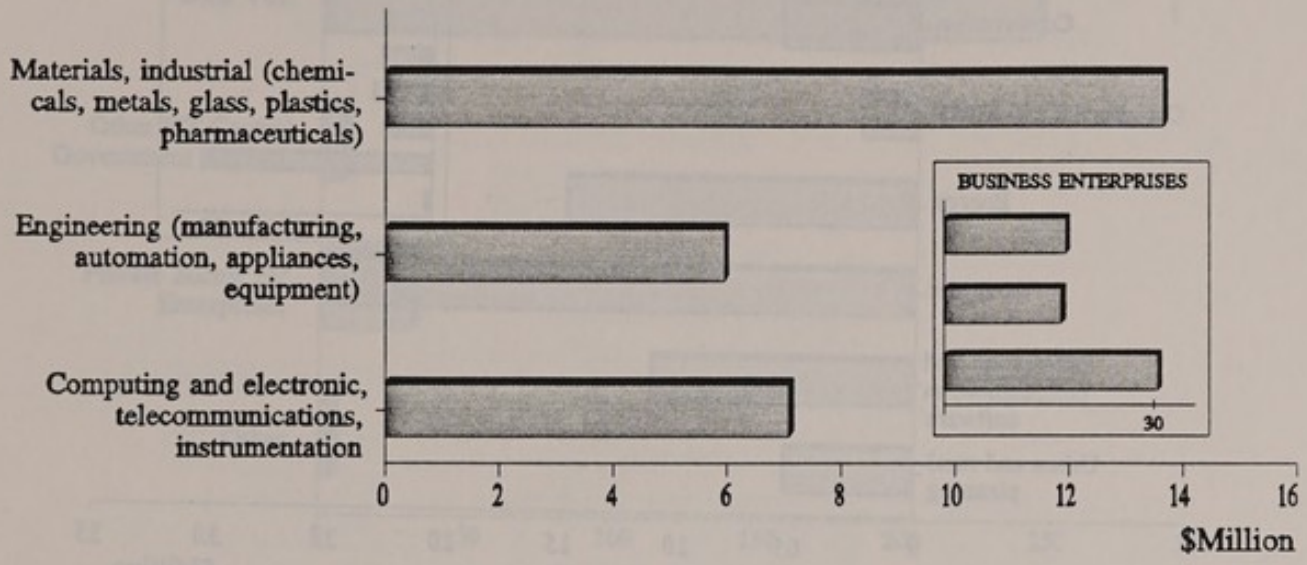


Table 4. INTRAMURAL GOVERNMENT SECTOR R&D, MATERIALS, ENGINEERING, COMPUTING AND COMMUNICATION, 1989/90

Output Class	Title	($'000)	Percent
16	Materials and industrial processes and products, (chemicals, metals, glass, plastics, pharmaceuticals)	13,673	51.1
17	Engineering processes (manufacturing, automation,appliances, and industrial, transport and construction equipment)	5,966	22.3
18	Computing and electronic, communication and instrumentation processes, products and equipment	7,106	26.6
	Total	26,746	100.0

Note: Columns will not always agree with totals shown due to rounding of individual estimates.

Output classes 17 and 18 each received about one-quarter of the funding within this area (22 and 27 percent respectively).

By contrast, output class 18 received about half the funding in the business enterprise sector's R&D, with output classes 16 and 17 each receiving about one-quarter.

7.5 Infrastructure and services

The area of 'Infrastructure and services' (output classes 19 to 24) was more important in the business enterprise sector than in the government sector, with 21 and 2 percent of funding respectively. However, this category does include output class 23 (dealing with computer software) which has been discussed above in section 7.4. Taking a broader definition of IT-related research would result in a large addition to the government sector's expenditure in output class 23.

Figure 5 shows government sector expenditure on R&D in the area of 'Infrastructure and services' (output classes 19 to 24), and the inset shows the business enterprise sector results. Table 5 gives the detailed statistics.

It is seen that the major effort in government R&D in this area was in output 22 ('New and improved information bases, processes and systems for transport'), which comprised nearly 40 percent of the effort in this area.

Figure 5. INTRAMURAL GOVERNMENT SECTOR R&D, INFRASTRUCTURE AND SERVICES, 1989/90

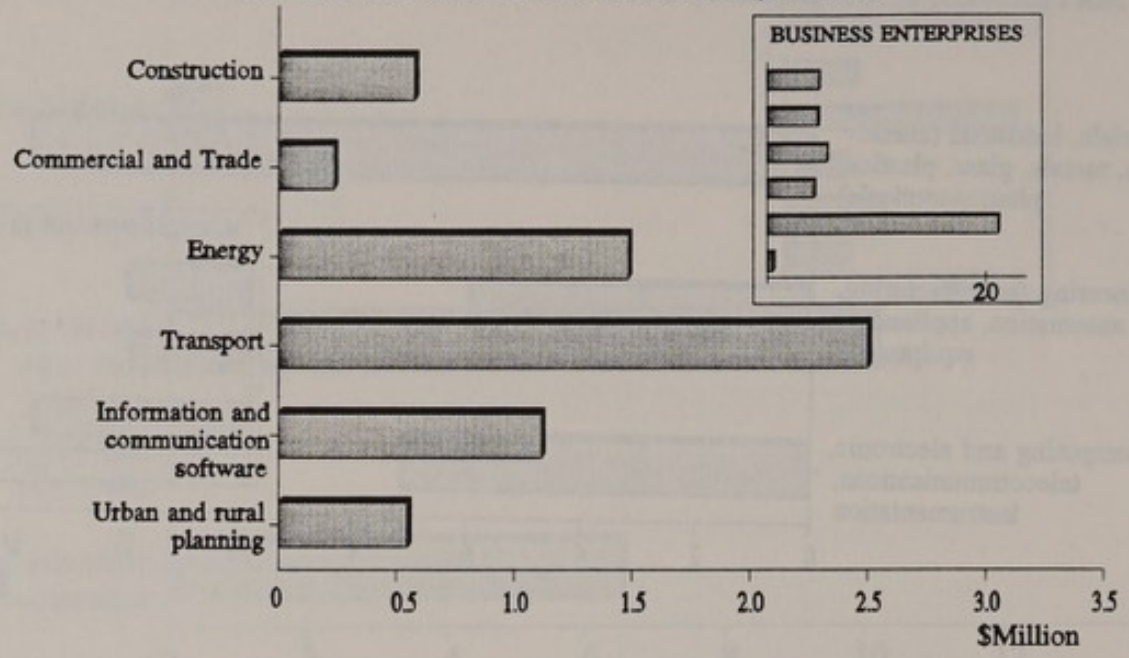


Table 5. INTRAMURAL GOVERNMENT SECTOR R&D, INFRASTRUCTURE AND SERVICES, 1989/90

Output Class	Title	($'000)	Percent
19	Construction processes, systems and products	580	9.0
20	Commercial and trade services (financial, wholesale, measurement and standards)	238	3.7
21	Energy production and use (exploration, assessment, transportation, economics etc.)	1,486	22.9
22	Transport (road safety, installations, handling and storage)	2,504	38.7
23	Information and communication software	1,118	17.3
24	Urban and rural planning	550	8.5
	Total	6,476	100.0

Note: Columns will not always agree with totals shown due to rounding of individual estimates.

7.6 Environment, exploration and assessment of the Earth

About a quarter (26 percent) of the R&D funding in the government sector was in the area of 'Environment, exploration and assessment of the Earth', namely in output classes 29 to 35 as listed in Annex 3 and summarised in Table 1. This involves research into New Zealand's environment and natural resources. By contrast this kind of research comprised only 3 percent of the R&D of the business enterprise sector.

As seen in Table 1, output classes 30 and 32, which deal with 'Geological structures' and 'Marine and fresh waters' respectively, received about equal funding and together comprise nearly half the government expenditure in this category (48 percent). Output class 31, which deals with R&D into different types of land and land-based flora and fauna, was the next most important (21 percent).

8 Source of funds for intramural R&D

In the survey, organisations were asked to provide information on the source(s) of the funds for the R&D they undertook. The results are summarised in Figure 6, with details given in Table 6.

Figure 6. SOURCE OF FUNDS FOR INTRAMURAL GOVERNMENT SECTOR R&D, 1989/90

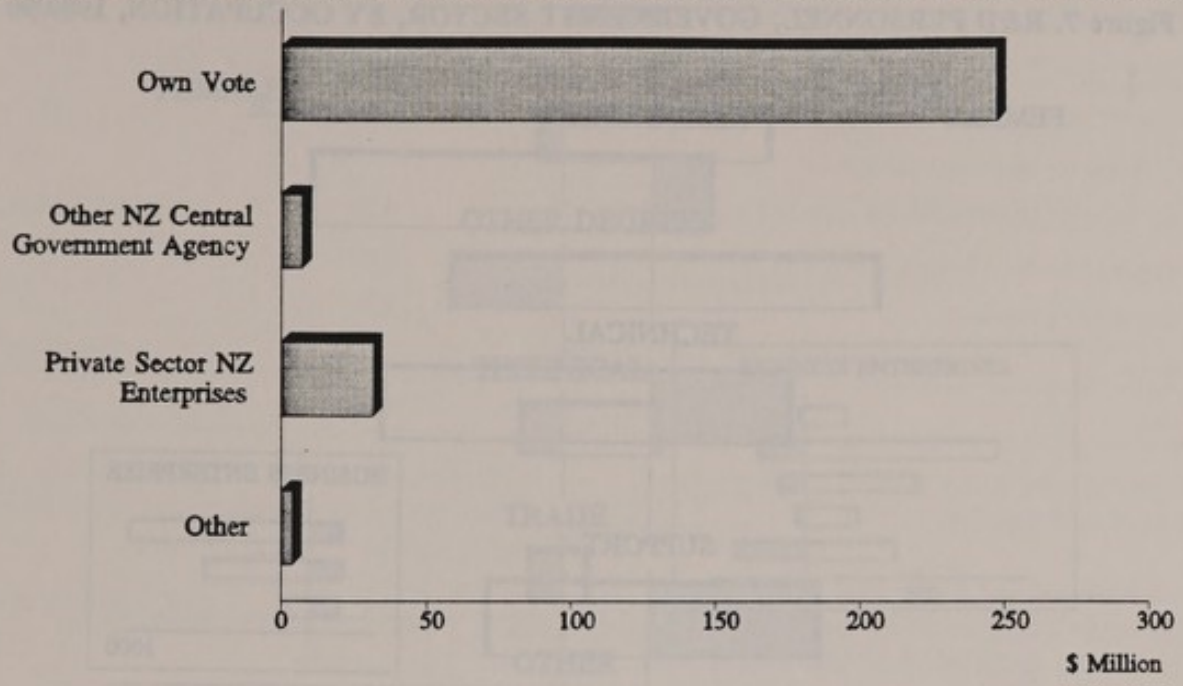


Table 6. SOURCE OF FUNDS FOR INTRAMURAL GOVERNMENT SECTOR R&D, 1989/90

Title	($'000)	Percent
Own Vote from Parliament	247,618	85.3
Other NZ Central Government Agency	7,160	2.5
NZ Local Government	398	0.1
NZ Tertiary Education Sector	518	0.2
Private Sector NZ Enterprises	31,728	10.9
Funds from Abroad	1,843	0.6
Other Sources of Funds	922	0.3
Total	290,186	100.0

The bulk of funding (85 percent) during this period came from 'own vote', namely science funding allocated by Parliament to individual organisations (e.g. Vote DSIR). As discussed in section 2, this system of organisational funding has since been replaced by a contestable science funding system.

A further 11 percent of funding for Government research was obtained from private sector enterprises for research undertaken on contract.

This information can be compared with that in the Business Enterprise Sector report [1], namely 71 percent of funding in the business enterprise sector came from their own funds, while 7 percent came from government sources.

On completion of the three parallel surveys, it will be possible to evaluate the total amount of government spending on R&D in the three sectors, while the commercial work done by the government and higher education sectors will be added to the 'own funds' R&D described in the business enterprise survey to give the full contribution to R&D of the business enterprise sector in New Zealand.

9 R&D personnel

9.1 Occupations

Government organisations were asked to provide information on their total number of R&D personnel, as well as breakdowns by gender and occupation. Figures were provided in full-time equivalent (FTE) staff numbers

Figure 7. R&D PERSONNEL, GOVERNMENT SECTOR, BY OCCUPATION, 1989/90

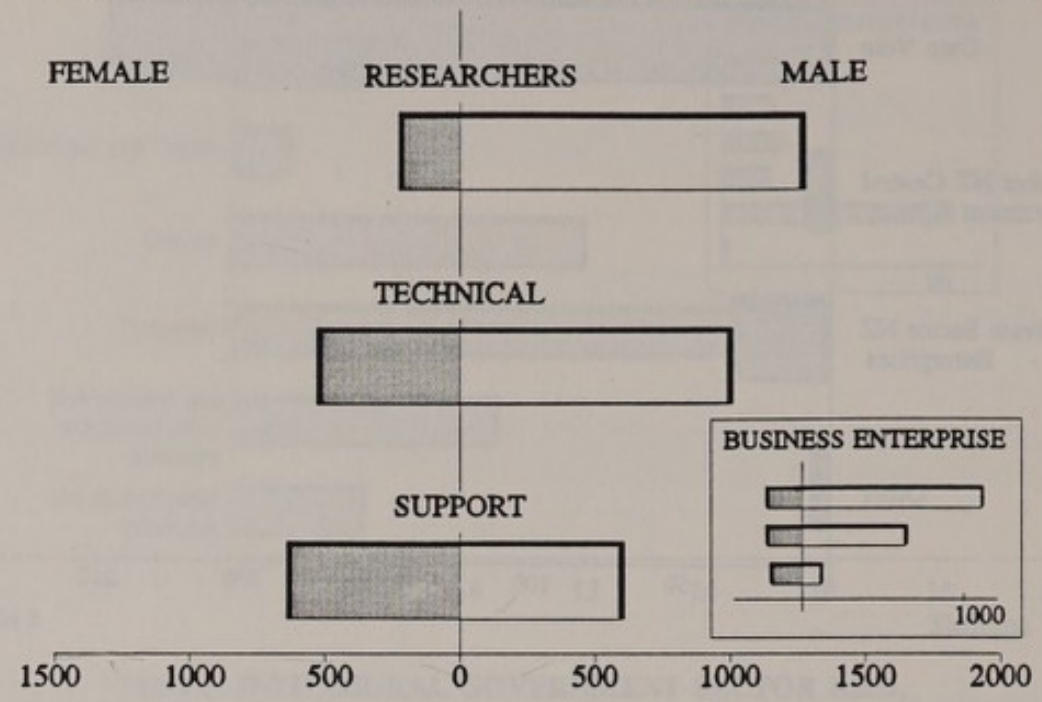


Table 7. R&D PERSONNEL, GOVERNMENT SECTOR, BY OCCUPATION, 1989/90

Gender	Title	Number	Percent
MALE	Researchers	1,259	30.1
	Technical	992	23.7
	Support	589	14.1
FEMALE	Researchers	205	4.9
	Technical	511	12.2
	Support	623	14.9
	Total	4,180	100.0

and are given in Table 7 and in Figure 7, with the inset showing the comparable results from the business enterprise survey.

The total number of FTE personnel employed in R&D in the government sector came to 4,180, which can be compared with 2,826 in the business enterprise sector.

Support staff made up 29 percent of FTE personnel employed in R&D by the government sector. This is correspondingly higher than the percentage (12) in the business enterprise sector.

Of the government R&D personnel, 2,840 (68 percent) were male and 1,339 (32 percent) were female. By comparison, in the business enterprise sector 76 percent were male and 24 percent were female.

The statistics also show gender differences in the three occupational categories. As seen in Figure 7 and the inset, there were approximately equal numbers of men and women in both sectors in the 'support' area. In the 'technical' area men dominated by about 2 to 1. Among the 'researchers' the profession was clearly male-dominated, with a ratio of about 6:1 in both sectors.

9.2 Qualifications

Government organisations were asked to provide information on the highest qualifications of their R&D personnel, as well as breakdowns by gender.

Figure 8. R&D PERSONNEL, GOVERNMENT SECTOR, BY HIGHEST QUALIFICATION, 1989/90

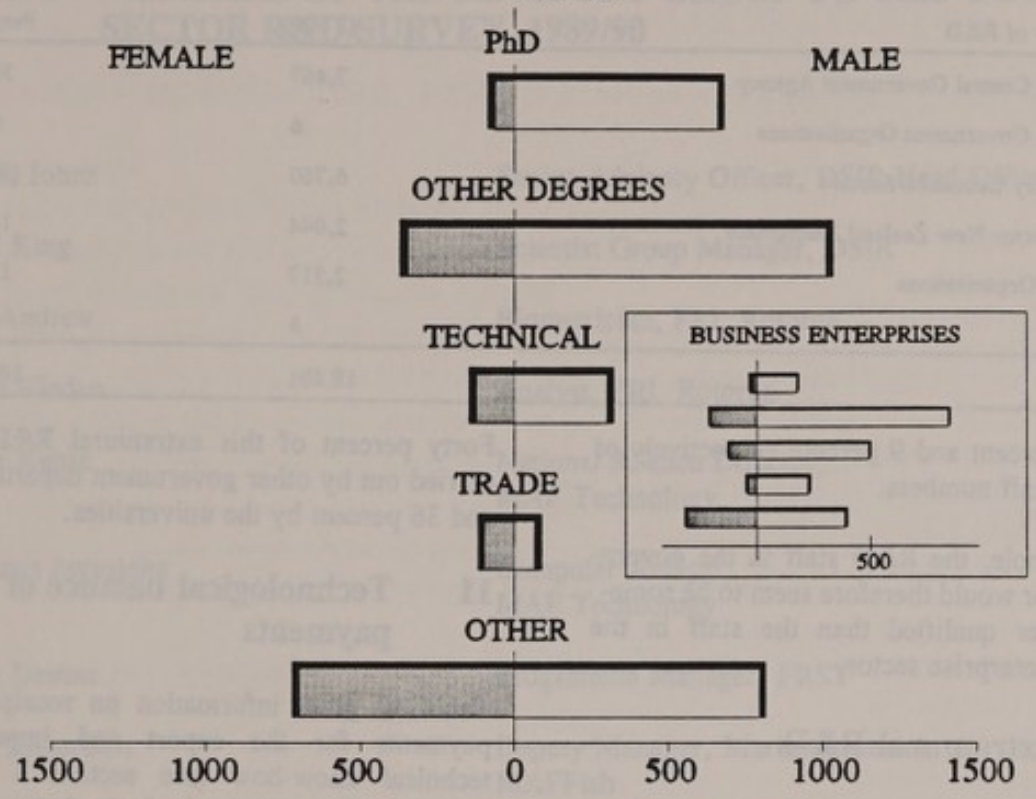


Table 8. R&D PERSONNEL, GOVERNMENT SECTOR, BY HIGHEST QUALIFICATION, 1989/90

Gender	Qualification	Number	Percent
MALE	PhDs in Science/Engineering	661	15.8
	Other Degrees	1,013	24.2
	Technical Qualifications	302	7.2
	Trade Qualifications	66	1.6
	Other Qualifications	798	19.1
FEMALE	PhDs in Science/Engineering	66	1.6
	Other Degrees	349	8.3
	Technical Qualifications	126	3.0
	Trade Qualifications	100	2.4
	Other Qualifications	699	16.7
	Total	4,180	100.0

Note: Columns will not always agree with totals shown due to rounding of individual estimates.

Figures were provided in full-time equivalent (FTE) staff numbers, and are given in Table 8 and Figure 8, with the inset presenting the information for the business enterprise sector. The percentage of R&D personnel with PhDs in science or engineering was higher in the government sector than in the business enterprise sector, being 17 percent and 7 percent respectively of the total staff numbers.

The percentage of R&D personnel with other degrees was slightly lower in the government sector than in the business enterprise sector, being 32 percent and 37 percent respectively of the total staff numbers.

The percentage of R&D personnel with trade qualifications was lower in the government sector than in the business enterprise sector,

TABLE 9. EXTRAMURAL R&D FUNDED BY GOVERNMENT ORGANISATIONS, 1989/90

Performer of R&D	($'000)	Percent
Other NZ Central Government Agency	7,467	39.7
NZ Local Government Organisations	6	0.0
NZ Tertiary Education Sector	6,760	36.0
Private Sector New Zealand Enterprises	2,044	10.9
Overseas Organisations	2,517	13.4
Other	8	0.0
Total	18,801	100.0

being 4 percent and 9 percent respectively of the total staff numbers.

On the whole, the R&D staff in the government sector would therefore seem to be somewhat better qualified than the staff in the business enterprise sector.

10 Extramural R&D

Table 9 shows extramural R&D, that is, R&D which is funded by government organisations but undertaken by others.

Government departments spent $18.8 M on R&D contracted out to other organisations.

Forty percent of this extramural R&D was carried out by other government departments, and 36 percent by the universities.

11 Technological balance of payments

Table 10 gives information on receipts and payments for the export and import of technical know-how (see section 5 for a definition of technological balance of payments.)

The government sector received a net amount of $1.1 M in receipts from abroad for the sale of technical know-how.

TABLE 10. TECHNOLOGICAL BALANCE OF PAYMENTS FOR THE GOVERNMENT SECTOR, 1989/90

Nature of payment	($'000s)
Receipts from Abroad	1,657
Payments Abroad	577
Balance	1,080

ANNEX 1 MEMBERS OF THE ADVISORY GROUP TO THE GOVERNMENT SECTOR R&D SURVEY, 1989/90

Dr David Johns	Senior Advisory Officer, DSIR Head Office
Mr Earl King	Scientist Group Manager, DSIR
Mr Ian Andrew	Biometrician, FRI, Rotorua
Mrs Sue Vinden	Analyst, FRI, Rotorua
Dr Peter Kettle	National Science Director, MAF Technology
Mr Channa Jayasinha	Computer Analyst, MAF Technology
Dr Sean Devine	Programme Manager, FRST
Dr Don Robertson	Deputy Manager, Marine Research MAFFish
Dr Rob Whitney	Research Associations' Co-ordinating Committee

Ministry of Research, Science and Technology:

Dr Margriet Theron	Manager, Science Review (Chair)
Dr Roger Waite	Science Review Convener
Ms Barbara Rouse	Science Review Convener
Ms Pamela Walker	Science Resource Analyst (Convener)

ANNEX 2 GOVERNMENT SECTOR ORGANISATIONS WHICH UNDERTAKE R&D

Accident Compensation Corporation
Agricultural & Marketing R&D
Alcoholic Liquor Advisory Council
Audit Office
Department of Justice
Department of Labour
Department of Internal Affairs
Department of Social Welfare
Department of Health, National Radiation Laboratory
Department of Scientific & Industrial Research
Department of Conservation
Department of Health, Communicable Disease Centre
FRI, Pulp & Paper Research Organisation
FRI Forest Technology
FRI, Wood Technology
FRI, Forest & Wildland Ecosystems
Hillary Commission
Human Rights Commission
MAF Marine Research
MAF Noxious Plants Council
MAF Pesticides Board
MAF Technology
MAF Freshwater Fisheries NZ
Maori Language Commission
Ministry of Commerce
Ministry of Defence, Defence Scientific Establishment
Ministry of Education
Ministry of External Relations
Ministry of Maori Affairs
Ministry for the Environment
Ministry of Transport
Ministry of Youth Affairs
National Museum
NZ Council for Educational Research
NZ Historic Places Trust
NZ Lottery Grants Board
NZ Tourism Department
NZ Planning Council
Race Relations Conciliator
Securities Commission
Standards Association
Waitangi Tribunal

ANNEX 3 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

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. Science and Technology Advisory Committee; 1988. "Science and Technology Statement 1988" Wellington.

3. OECD; 1981. "The Measurement of Scientific and Technical Activities" Paris. *Frascati Manual*