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

New Zealand Research and Experimental Development Statistics

Business Enterprise Sector, 1989/90.

Ministry of Research, Science and Technology

Te Manatu Putaiao

Publication No.1

Cover: Major areas of business enterprise R&D (Clockwise)

1. Software development; the computer storage area at UNISYS LINC Development Centre, Christchurch.

2. Dairy processing; bacreators, at Hautapu butter factory.

3. Information technology; this eighteen meter satellite dish points at Intelsat. It weighs 50 tons, and transmits and receives TV and telephony.

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This report was prepared by Pamela Walker, Science Resource Analyst of the Ministry of Research, Science and Technology. The joint survey was carried out by the Economics and Business Surveys Division (Senior Manager David Archer, Senior Survey Officer Roger Parkes) of the Department of Statistics, Auckland.

Approved for general release

Basil Walker
Chief Executive

FOREWORD

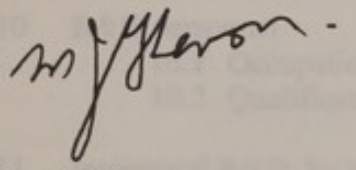
This survey of research and development in the business enterprise sector is the first of a series of R&D surveys to be undertaken by the Ministry of Research, Science and Technology. It was carried out jointly with the Economic and Business Surveys Division of the Department of Statistics in Auckland, 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 key sectors of the science and science user communities. 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 business community were generally very willing to provide the information and to participate in the survey. I would like to thank the survey officer at the Department of Statistics who managed, in close consultation with this Ministry, the queries which a technical and complex survey of this nature could be expected to generate .

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, together with the addition of similar information from the public sector.

The value of information on R&D increases the longer the time frame over which it is available. This survey will therefore be repeated annually, with the next questionnaire due for dissemination in August 1991.



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

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EXECUTIVE SUMMARY

One of the functions of the Ministry of Research, Science and Technology is to collect statistics on research in New Zealand. This report presents the results of the first completed survey, of the business enterprise sector.

The survey sample totalled 2,508 enterprises, representing a population of 7,904, selected by activity and size from those industry groups likely to engage in R&D. The survey covered business enterprises trading in New Zealand, including Research Associations, State-owned enterprises and local government.

Expenditure on R&D carried out in the business enterprise sector for the year ended June 1990 totalled $200.05 million, or 0.29 percent of gross domestic product. R&D was carried out by 1,027 enterprises while 315 were funding R&D carried out by others.

The top five firms carrying out R&D accounted for $51.5 million or 26 percent of total R&D expenditure, while 34 percent was accounted for by the top ten firms. The top 29 enterprises accounted for 50 percent of total expenditure, thus half of the R&D being carried out was concentrated in the top three percent of providers.

Of the total of $200 million spent on intramural R&D, almost one third ($65 million) was aimed at better ways to process primary products (meat, dairy, fruit, fibres, wood etc). In particular, $29 million was on research aimed at dairy processes, storage techniques and products.

Another third was aimed at the development of materials and industrial processes, engineering products and processes, and computing, electronic, telecommunication and instrumentation systems and products. Of the $65 million in this group, $31 million was spent on research aimed at instrumentation and information and communication technology 'hardware'.

Materials, industrial processes and products, including chemicals, plastics and pharmaceuticals, accounted for $18 million, and engineering processes (automation, appliances, and industrial, transport and construction equipment) for $17 million.

Twenty-one percent of the research ($42 million) was aimed at the development of improved infrastructure and services. These include: construction, trade services, energy, transport, information and communication services and urban and rural planning.

Most significantly, more than half of the infrastructure and services R&D was for new and improved information processing software, software and services for telecommunication, media transmission and data interchange. When this is combined with information and communications technology hardware R&D, it is clear that information and communications technology is by far the largest area of business enterprise R&D in New Zealand. Together, these total $52 million, or a quarter of all the business enterprise R&D.

Business enterprises targeted $14 million at agricultural, horticultural, forestry and fisheries research and $4.5 million at health research. Research aimed at the protection of the environment took $3 million, and geological research another $2 million. Research on social development, including economic research, added another $2 million.

The total number of personnel employed in R&D came to 2,826 full-time equivalents. Of these, 2,141 (76 percent) were male and 685 (24 percent) female.

Wages and salaries consumed 57 percent of the $200 million allocated to R&D in the business enterprise sector. Other current expenditure accounted for 32 percent and capital expenditure for the remaining 11 percent.

1 Background

This is the first comprehensive survey of research and experimental development carried out within or funded by the private sector to be undertaken according to international definitions in New Zealand.

In line with Organisation for Economic Co-operation and Development (OECD) practice, the survey was based on information gathered from research and development providers, not from funding sources.

The survey conforms to OECD standards for the collection of research and experimental development statistics. It will be used to fulfil New Zealand's international obligations to provide R&D statistics.

The purpose of the survey was to produce summarised statistics of research and development activities in New Zealand for release to Government, business and other users in the community. Parallel surveys are being conducted for the Government and Higher Education sectors, in order to generate a full picture of research and development in New Zealand.

This information will allow Government funded research to be targeted toward areas which are not being addressed adequately by other sources. This will help to ensure that research and development activity as a whole is in line with national priorities and reflects long term economic aims and opportunities.

These 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.

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 of *new or improved* materials, products, devices, processes or services. R&D ends when work is no longer primarily investigative.

2 A historical note

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 manufacturing sector was collected by the Department of Statistics in the manufacturing section of the economy wide census in 1986/87. This did not encompass business enterprise R&D from other sectors.

Prior to that, R&D information was collected in the biennial or triennial censuses of manufacturing. Full definitions of what should be included as R&D were not given, nor was it clear that R&D funded by the respondent but provided by others should not be included. The results probably overestimated R&D by OECD definitions for the manufacturing sector, and there was no information on the primary, infrastructure or service sectors.

3 Role of the Ministry

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 research and development including fulfilling international obligations to provide data on national science and technology.

The survey was conducted jointly with the Economic and Business Surveys Division of the New Zealand Department of Statistics, Auckland.

4 Survey methodology

An Advisory Group with representatives from Private Sector R&D providers, Producer Boards and Research Associations 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 business enterprises by the Survey of Research and Experimental Development for the year ended 30 June, 1990. This survey was based on a stratified random sample of businesses by size and from those industry sectors identified by the Advisory Group as being likely to carry out R&D. The questionnaire was tested by a pilot survey in August 1990 and the amended questionnaire was mailed out in November 1990. The final sample totalled 2,508 enterprises, representing a population of 7,904, selected by activity and size.

The results will be subject to sample errors. Sampling error is a measure of the variability that occurs by chance because a sample, rather than an entire population, is surveyed. The sample error for R&D expenditure at the total level (i.e. all industries combined or all outputs combined) is estimated at less than 5 percent. The sample errors for a finer analysis of the data will be significantly higher.

The survey included private sector enterprises trading in New Zealand, including Research Associations, State-owned enterprises and local government. It did not include government organisations or area health boards.

Most of the tables in this report represent expenditure on R&D *carried out by* the business enterprise sector, which is called "Business Enterprise R&D", or "BERD" in OECD tabulations. Total *funding* of R&D by the business enterprise sector includes that for R&D carried out in other sectors (government, universities, abroad).

The response rate for the survey was 90.4 percent. Of 241 outstanding, 19 were deleted as duplicates or because they were not trading during the period. Data for the remaining 222 were imputed. All enterprises with more than 94 full-time persons employed provided a response.

The method of non-response imputation was as follows: all enterprises were classified into cells based on the sample selection cells i.e. by size and activity. The questionnaires that replied to the survey were then summarised along with their full-time equivalent workforce figure (FTE) in order to calculate values per FTE. Non-respondents' values were then imputed by multiplying the appropriate cell value per FTE by the non-respondents' FTE value. Where the cell represented a sample stratum, values were weighted by the sample weights. Data estimated for non-respondents amounted to 3 percent of total R&D expenditure recorded.

5 Main results

Expenditure on R&D carried out in the business enterprise sector for the year ended June 1990 totalled $200.05 million. As a percentage of Gross Domestic Product (GDP) this amounted to 0.29 percent (using GDP at March 1990 of $69,785 million).

Of the 7,904 enterprises in the population surveyed, 1,179 are estimated to be carrying out some form of R&D activity (either undertaking or funding R&D or buying or selling technical know-how, or a combination of these). R&D was carried out by 1,027 enterprises while 315 were funding R&D which was carried out outside the enterprise. These categories are not mutually exclusive; some providers are also funders.

The results show that in the survey population, which does not cover all industries, 7 per thousand workforce are engaged in R&D (2,826 FTE personnel are performing R&D out of an estimated workforce of 406,108 FTEs employed by the 7,904 enterprises). Enterprises performing R&D had an estimated total FTE of 166,301, thus 1.7 percent of their workforce were engaged in R&D.

The top five firms carrying out their own R&D accounted for $51.5 million or 26 percent of total R&D expenditure, while $67.3 million or 34 percent was accounted for by the top ten firms. Thirty-two enterprises carried out R&D to the value of $1 million or more, while the top 29 enterprises accounted for 50 percent of total expenditure. Thus half of the R&D being carried out was concentrated in the top three percent of providers.

6 Definitions used in the survey

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

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. (Refer to paragraphs 8.4 and 8.5 for R&D expenditure in these areas.)

A more comprehensive interpretation of the definition of R&D activity is given in the OECD publication *The Measurement of Scientific and Technical Activities* ("Frascati Manual") OECD, Paris, 1981.

Intramural R&D statistics presented in this publication refer to R&D activity *carried out* by a business enterprise on its *own* behalf or on behalf of other enterprises, institutions or individuals. The first twelve figures represent intramural R&D.

Extramural R&D statistics presented refer to R&D activity *funded* by a business enterprise but *carried out* by other enterprises, institutions or individuals. Table 13 represents extramural R&D.

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, repairs, 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, secretarial and clerical staff directly associated with R&D activity.

Technology 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; licences; technical data and information; scientific, technical or engineering assistance that increases technical knowledge and understanding in the business.

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 business.

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

7 Scope of the survey

The scope of this survey is all enterprises within the Business Enterprise Sector of New Zealand subject to the selection criteria in section 4.

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 and their producer boards, private non profit organisations and local authorities.

The sample was targeted mainly at R&D providers rather than funders.

Farming enterprises (i.e. industries in major group 111 of the *New Zealand Standard Industrial Classification (NZSIC)*, 1987 edition) were excluded from the survey, partly because of collection difficulties and partly because such enterprises are believed to have very low R&D activity. Agricultural R&D activity is generally carried out by specialised research associations not normally included in NZSIC major group 111. For the purposes of R&D statistics, the OECD recommends that such research institutes be classified to the industry they predominantly serve, and this recommendation has been followed in this report. The predominant output area specified by the research association was used as a guide, and supplementary NZSIC codes assigned and used in all tables for the data provided by the research association.

Each enterprise is classified to the industry in which it mainly operates even though one or more of its component activity units (factories, shop, etc.) may be classified to other industries. For further comment see the *New Zealand Standard Industrial Classification*, 1987 Edition, Department of Statistics Catalogue Number 19.005.

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

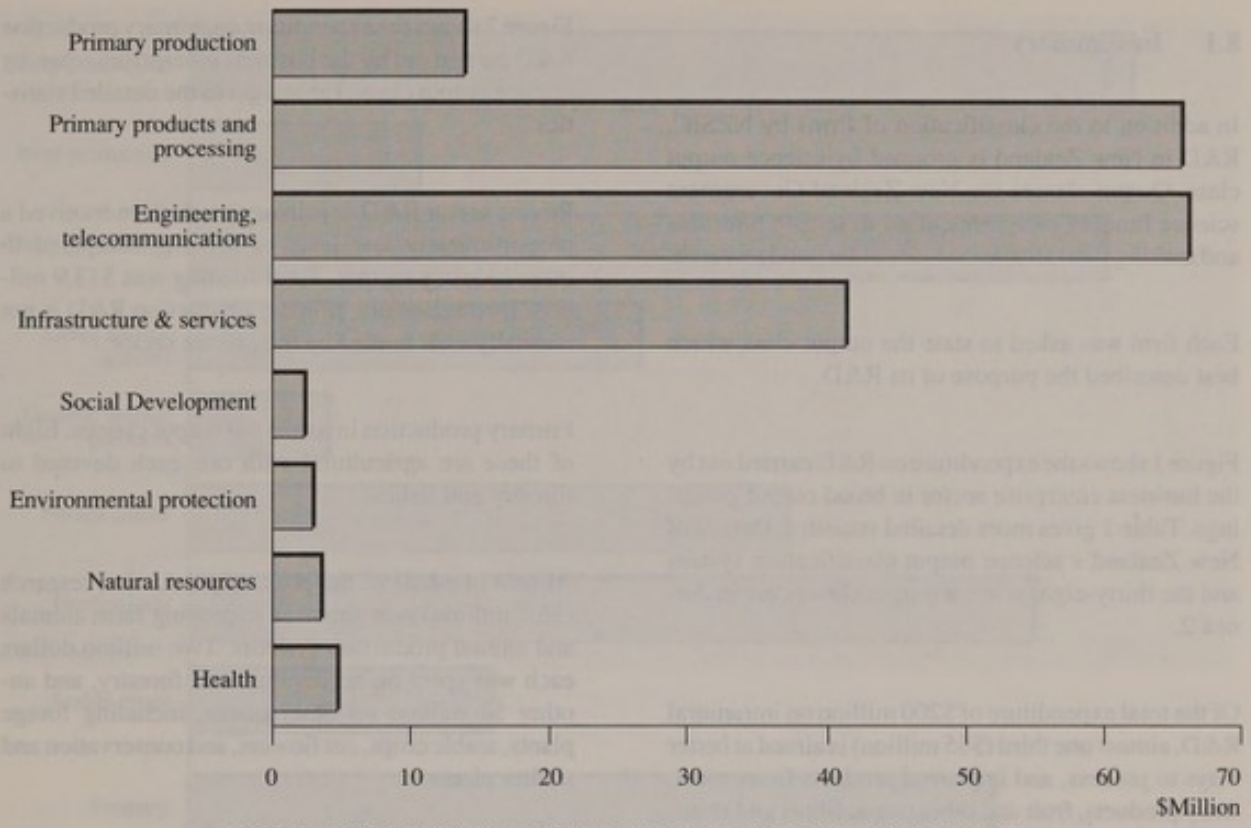

Table 1. TOTAL INTRAMURAL BUSINESS ENTERPRISE R&D, BY SCIENCE OUTPUT CLASS, 1989/90

Output Class		Title		($'000)	Percent
1 -10		Primary production		13,894	7.0
11-15		Primary products and processing		65,082	32.5
16-18		Materials, engineering, telecommunications		65,186	32.6
19-24		Infrastructure and services		41,590	20.8
25-28		Social development		2,285	1.1
	25	NZ history, society & culture	161		
	26	Relationships and wellbeing	217		
	27	Political, economic relationships	1,831		
	28	Education and training	76		
29		Environmental protection		2,899	1.5
30-36		Natural resources		*3,802	1.9
	30	Geological structures	2,061		
	31	Land use flora and fauna	n.p.		
	32	Marine and fresh water	649		
	33	Climate and atmosphere	16		
	34	Space	503		
	35	Antarctica	0		
	36	Fundamental knowledge	573		
37		Health		4,466	2.2
38		Defence		n.p.	n.p.
		Total		200,048	100.0

Note:The first four groups are expanded in figures 2-5. Columns will not always agree with totals shown due to rounding of individual estimates. n.p. = not for publication due to confidentiality.
** total does not include Output 31.*

8 Intramural R&D, by science output class

8.1 In summary

In addition to the classification of firms by NZSIC, R&D in New Zealand is grouped by science output class. Output classes are New Zealand Government science funding categories, used in setting priorities and making fund allocations for public good research.

Each firm was asked to state the output class which best described the purpose of its R&D.

Figure 1 shows the expenditure on R&D carried out by the business enterprise sector in broad output groupings. Table 1 gives more detailed statistics. Details of New Zealand's science output classification system and the thirty-eight science output classes are in Annex 2.

Of the total expenditure of $200 million on intramural R&D, almost one third ($65 million) is aimed at better ways to process, and improved products from, meat, dairy products, fruit and other crops, fibres and skins, and wood and paper.

Another third of the R&D ($65 million) is aimed at the development of new and improved materials and industrial processes, engineering products and processes, and computing, electronic, telecommunication and instrumentation processes, systems and products.

Twenty-one percent of the research ($42 million) is aimed at 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.

The business enterprises targeted $14 million (seven percent of the total) at agricultural, horticultural, forestry and fisheries research; and $4.5 million (2 percent) at health research. Research aimed at the protection of the environment (which includes pollution and waste management) took $3 million, and geological research another $2 million. Research on social development, including economic research, added another $2 million.

8.2 Primary production

Figure 2 shows the expenditure on primary production R&D carried out by the business enterprise sector, by science output class. Table 2 gives the detailed statistics.

Private sector R&D in primary production received a proportionately low level of funding compared to other industry sectors. Total funding was $13.9 million. Internationally, primary production R&D is not normally well funded by the private sector.

Primary production involves ten output classes. Eight of these are agricultural with one each devoted to forestry and fishing.

Almost one-half of the primary production research ($6.7 million) was aimed at improving farm animals and animal production systems. Two million dollars each was spent on horticulture and forestry, and another $2 million on other plants, including forage plants, arable crops, cut flowers, and conservation and shelter plants.

The private sector also undertook research to the value of $1 million aimed at marine and freshwater fisheries.

8.3 Primary products and processing

Figure 3 shows the expenditure on primary products and processing R&D carried out by the business enterprise sector, by science output class. Table 3 gives the detailed statistics.

The substantial expenditure on this group of output classes (a total of $65 million) reflects the economic importance of these primary products in the New Zealand economy, and the presence of research associations and producer and marketing boards in the meat, dairy, wool, and fruit sectors.

Business enterprises spent $29 million on research aimed at the development of new and improved dairy processes, storage techniques and products. This is the second highest of all the output classes, after computing and electronics.

Figure 2. INTRAMURAL BUSINESS ENTERPRISE R&D, PRIMARY PRODUCTION, 1989/90

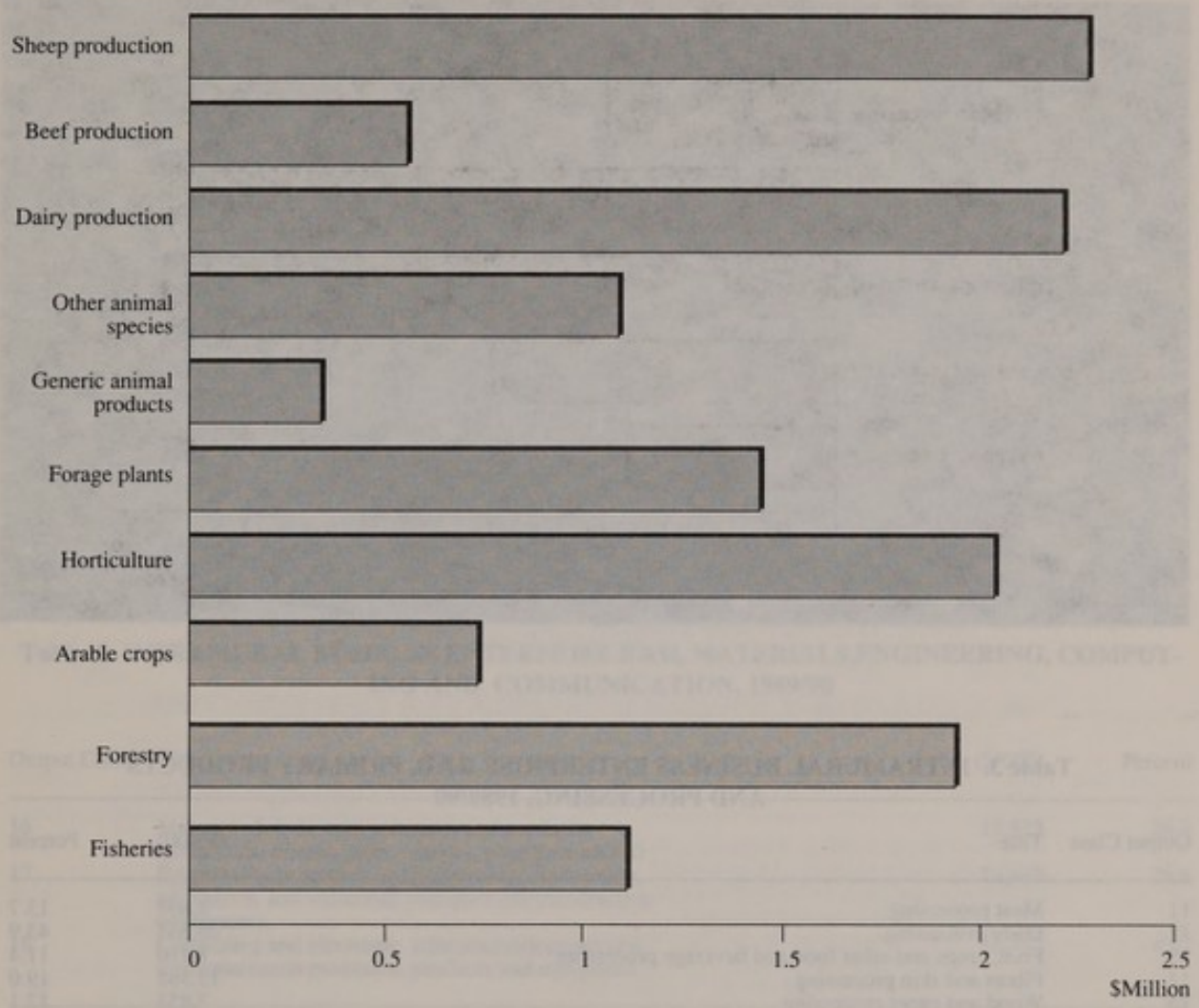

Table 2. INTRAMURAL BUSINESS ENTERPRISE R&D, PRIMARY PRODUCTION, 1989/90

Output Class	Title	($'000)	Percent
1	Sheep and sheep production systems	2,248	16.2
2	Beef animals and beef production systems	550	4.0
3	Dairy animals and dairy production systems	2,493	17.9
4	Other animal species, animal products and primary production systems	1,082	7.8
5	Generic animal and animal production information bases, systems and products	334	2.4
6	Forage plants and forage management practices	1,426	10.3
7	Horticultural crops and management practices	2,017	14.5
8	Arable crops, ornamental, amenity, shelter, conservation and other plants and management practices	723	5.2
9	Forest trees and plantations management systems	1,927	13.9
10	Fish harvesting and production systems for marine and freshwater fisheries	1,094	7.9
	Total	13,894	100.0

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

Figure 3. INTRAMURAL BUSINESS ENTERPRISE R&D, PRIMARY PRODUCTS AND PROCESSING, 1989/90

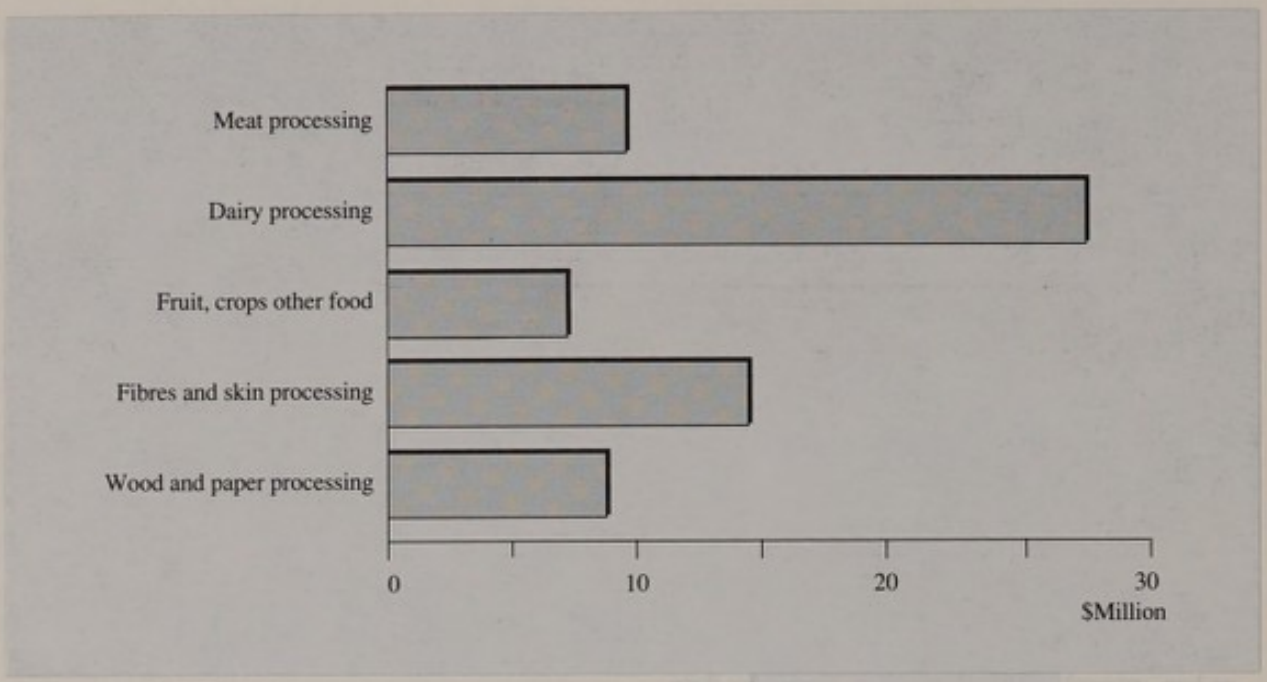

Table 3. INTRAMURAL BUSINESS ENTERPRISE R&D, PRIMARY PRODUCTS AND PROCESSING, 1989/90

Output Class	Title	($'000)	Percent
11	Meat processing	8,897	13.7
12	Dairy processing	28,561	43.9
13	Fruit, crops and other food and beverage processing	7,410	11.4
14	Fibres and skin processing	12,361	19.0
15	Wood and paper processing	7,853	12.1
	Total	65,082	100.0

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

8.4 Materials, engineering, computing and communications

Figure 4 shows the expenditure on materials, engineering, computing and communications R&D carried out by the business enterprise sector. Table 4 gives the detailed statistics.

Of the $65 million in this group, $31 million is spent on research aimed at new and improved computing and electronic, tele-communication and instrumentation processes, products and equipment. This is the highest expenditure on intramural R&D of all the output classes.

New and improved materials, industrial processes and products, including chemicals, metals, glass, plastics and pharmaceuticals, accounted for $18 million, and engineering processes (manufacturing, automation, appliances, and industrial, transport and construction equipment) for another $17 million.

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

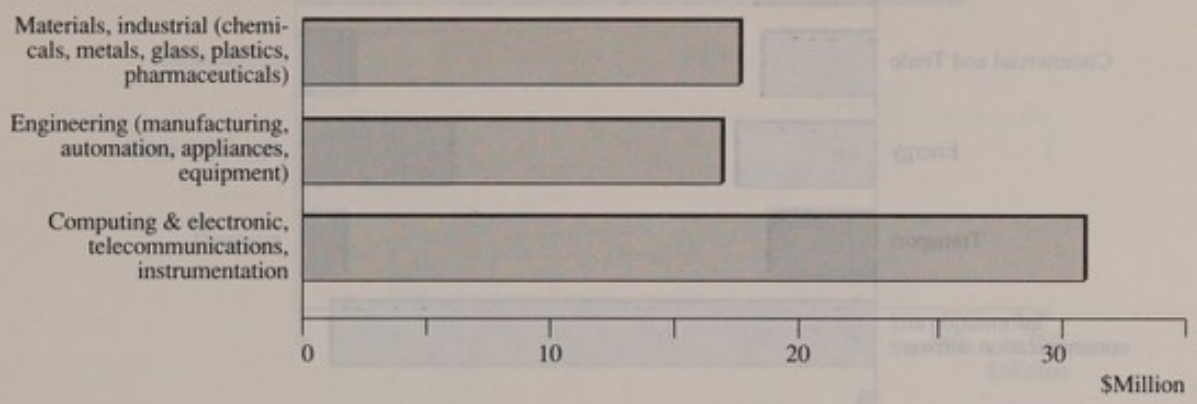

Table 4. INTRAMURAL BUSINESS ENTERPRISE R&D, MATERIALS,ENGINEERING, COMPUTING AND COMMUNICATION, 1989/90

Output Class	Title	($'000)	Percent
16	Materials & industrial processes and products, (chemicals, metals, glass, plastics, pharmaceuticals)	17,523	26.9
17	Engineering processes (manufacturing, automation, appliances, and industrial, transport and construction equipment)	16,889	25.9
18	Computing and electronic, telecommunications and instrumentation processes, products and equipment	30,774	47.2
	Total	65,186	100.0

8.5 Infrastructure and services

Figure 5 shows the expenditure on infrastructure and services R&D carried out by the business enterprise sector, by science output class. Table 5 gives the detailed statistics.

This rather mixed grouping includes construction and building ($5 million), commercial and trade services ($5 million), energy ($6 million), transport ($4 million), and urban and rural planning ($0.5 million).

Most significantly, more than half of the $41 million of R&D in this grouping ($22 million) is spent on new and improved information processing software, software and services for electronic communication, media transmission and data interchange. Much of the research in this output involves computer software research. When this is combined with Output 18 (Paragraph 8.4), which largely represents computer hardware, it is clear that computing systems are by far the largest area of business enterprise sector R&D in New Zealand. The two outputs total $52 million, or just more than a quarter of all the business enterprise R&D.

Figure 5. INTRAMURAL BUSINESS ENTERPRISE R&D, INFRASTRUCTURE AND SERVICES, 1989/90

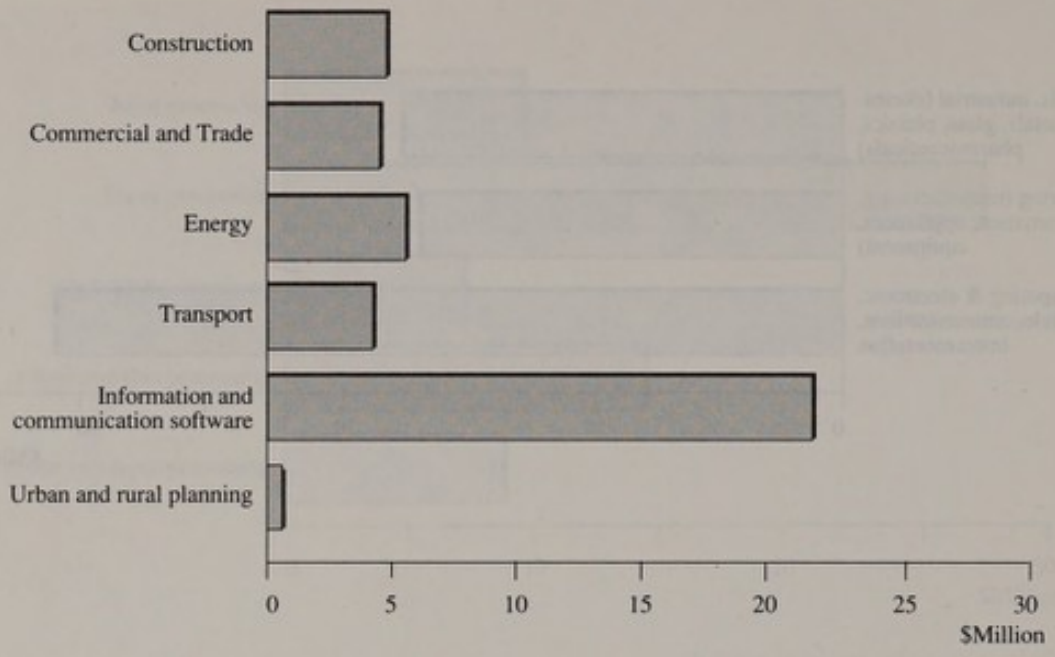

Table 5. INTRAMURAL BUSINESS ENTERPRISE R&D, INFRASTRUCTURE AND SERVICES, 1989/90

Output Class	Title	($'000)	Percent
19	Construction and building (including: materials, earthquake engineering, civil engineering)	4,785	11.5
20	Commercial and trade services (financial, wholesale, measurement and standards)	4,735	11.4
21	Energy production and use (exploration, assessment, transportation, economics etc.)	5,549	13.3
22	Transport (road safety, installations, handling and storage)	4,341	10.4
23	Information and communication services (generic software production R&D)	21,662	52.1
24	Urban and rural planning	518	1.3
	Total	41,590	100.0

9 Source of funds for intramural R&D

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

A very high proportion (71 percent) of R&D funding in the New Zealand private sector came from within the organisation which carried out the research. A further fourteen percent came from other related NZ private sector enterprises.

Smaller contributions came from the New Zealand central government (6.5 percent), other unrelated New Zealand private sector enterprises (2.8 percent), related private enterprises abroad (2.7 percent), and unrelated private enterprises abroad (2.5 percent).

The high portion of own funds used for R&D by the New Zealand business enterprise sector is in line with the experience in other countries, where this figure ranges from 98 percent for Japan to 67 percent for the USA.

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

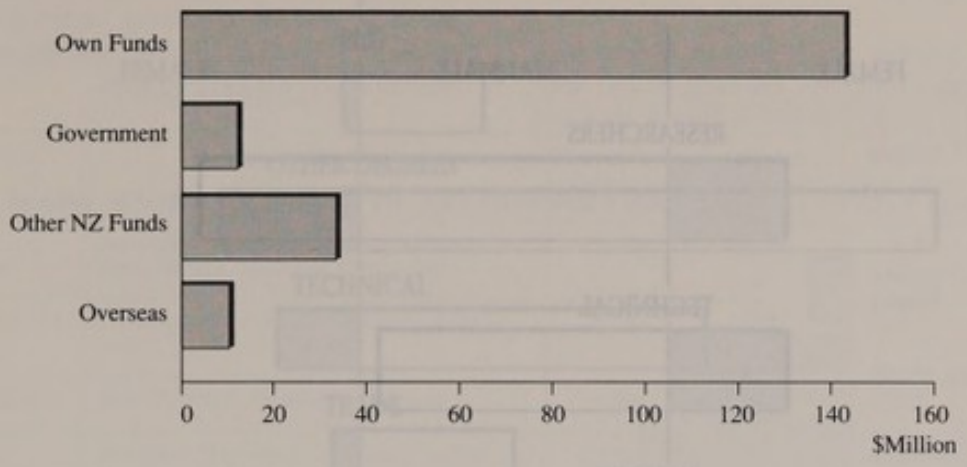

Table 6. SOURCE OF FUNDS FOR INTRAMURAL R&D, 1989/90

Title	($'000)	Percent
Own funds	141,285	70.6
NZ Central Government	12,951	6.5
NZ Local Government	572	0.3
Related Private NZ Firm	28,737	14.4
Unrelated Private NZ Firm	5,643	2.8
Overseas Funds From Related Firm	5,472	2.7
Overseas Funds From Un-related Firm	4,911	2.5
Other Sources of Funds	477	0.2
Total	200,048	100.0

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

10 R&D personnel

10.1 Occupations

Business enterprises were asked to provide information on the total number of R&D personnel, as well as breakdowns by gender and occupation. Figures were provided in full time equivalent (FTE) staff numbers, and are given in Figure 7 and Table 7.

The total number of personnel employed in R&D came to 2,826 FTE. Of these, 2,141 (76 percent) were male and 685 (24 percent) female.

Research and technical staff made up 88.1 percent of personnel employed in R&D by the private sector. The remaining 11.9 percent are support staff. The split between research and technical staff and support staff was found to be 85:15 in the 1987/88 Australian business enterprise R&D survey.

Also, while in New Zealand there is 0.64 technical staff member for each researcher, in Australia the ratio was 0.68 technical staff per researcher.

Amongst the women in business enterprise sector R&D, 35 percent are researchers, while 60 percent of the men are researchers.

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

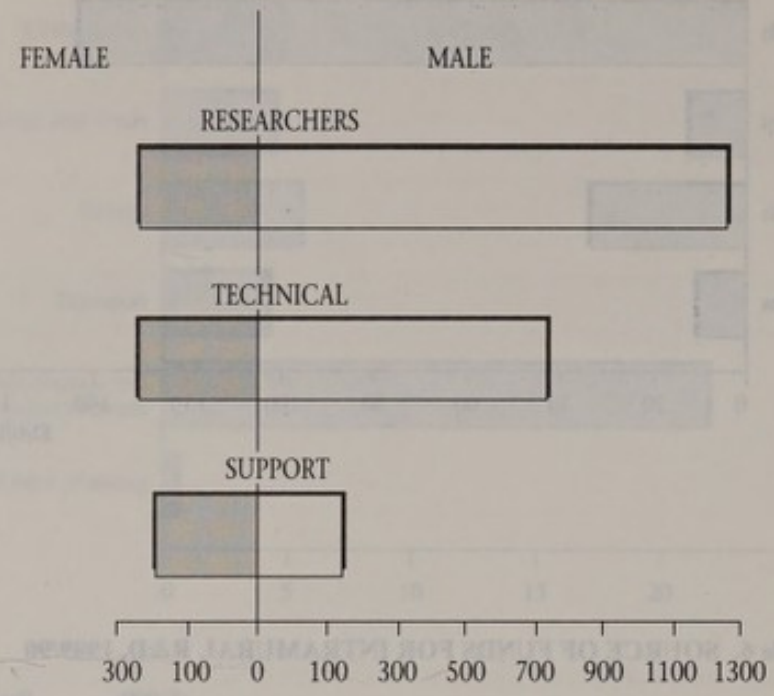

Table 7. R&D PERSONNEL, BY OCCUPATION, 1989/90

	Title	Number	Percent
FEMALE	Researchers	239	8.5
	Technical	239	8.5
	Support	207	7.3
MALE	Researchers	1,275	45.1
	Technical	735	26.0
	Support	131	4.6
	Total	2,826	100.0

10.2 Qualifications

Business enterprises were asked to provide information on the highest qualifications of their R&D personnel, as well as breakdowns by gender. Figures were provided in full time equivalent (FTE) staff numbers, and are given in Figure 8 and Table 8.

Among R&D staff in the private sector 6.9 percent had PhD qualifications in engineering or science. Only 3 percent of the women have PhDs, and 8 percent of the men.

Staff who held Bachelor degrees or higher (excluding engineering or science PhDs) made up 37 percent of R&D staff. These were the most common qualifications amongst R&D personnel.

People holding technical qualifications represented 22 percent of R&D personnel.

People holding trade qualifications represented nine percent of R&D staff. The gender balance in this traditionally male area remains heavily skewed.

Personnel holding "other" or "no" qualifications represent 25 percent of R&D staff. Only 18 percent of male employees had other or no qualifications, whilst 45 percent of female staff fell within this category.

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

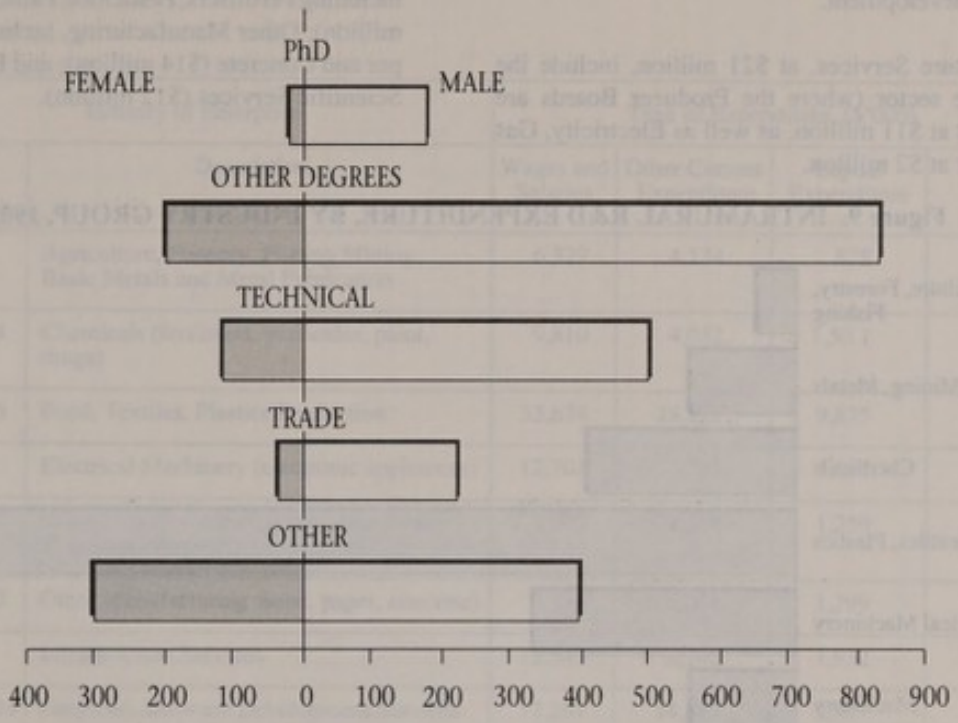

Table 8. R&D PERSONNEL, BY HIGHEST QUALIFICATION, 1989/90

	Title	Number	Percent
FEMALE	PhDs in Science/Engineering	21	0.8
	Other Degrees	201	7.1
	Technical Qualifications	120	4.2
	Trade Qualifications	37	1.3
	Other Qualifications	306	10.8
MALE	PhDs in Science/Engineering	174	6.2
	Other Degrees	848	30.0
	Technical Qualifications	499	17.6
	Trade Qualifications	226	8.0
	Other Qualifications	394	14.0
	Total	2,826	100.0

11 Intramural R&D, by industry group

In Paragraph 8, R&D undertaken by business enterprises is analysed according to science output class. The output class is an indication of the purpose of the research.

The results of the survey have also been analysed according to the industry to which the enterprises undertaking the R&D belong, using the Standard Industrial Classification. To protect confidentiality, while providing the maximum amount of additional information, enterprises were grouped into eleven industry groups. These are given in Figure 9, with the statistics given in Table 9.

In this analysis, the research associations were reclassified to the industry group that they predominantly serve.

The Food, Textiles, and Plastics Production group had the highest R&D expenditure, at $62 million out of the total of $200 million.

Financial and Software Development Services spent $34 million on R&D; of this, $29 million went to software development.

Infrastructure Services, at $21 million, include the Wholesale sector (where the Producer Boards are classified) at $11 million, as well as Electricity, Gas and Water at $2 million.

Other large R&D expenditures by industry groupings are: Electrical Machinery ($19 million); Chemicals, including Fertilisers, Pesticides, Paint, and Drugs ($15 million); Other Manufacturing, including Wood, Paper and Concrete ($14 million); and Engineering and Scientific Services ($12 million).

Figure 9. INTRAMURAL R&D EXPENDITURE, BY INDUSTRY GROUP, 1989/90

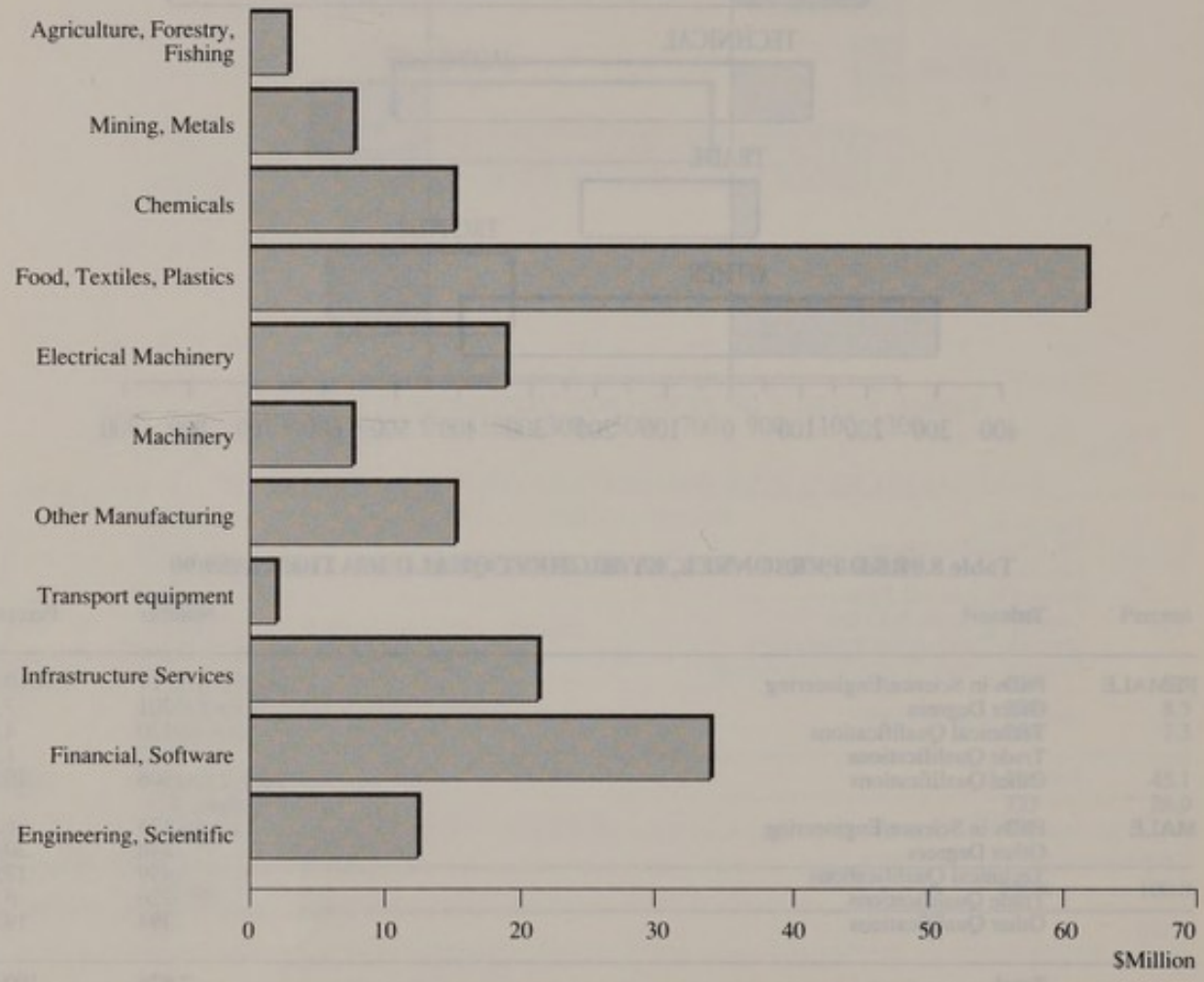

Table 9. INTRAMURAL R&D EXPENDITURE, BY INDUSTRY GROUP, 1989/90

NZSIC Code	Industry Group	Expenditure($'000)	Percent
1000	Agriculture, Forestry and Fishing	3,418	1.7
2000,371,372,381	Mining, Basic Metals and Metal Fabrication	7,923	4.0
351,352,353,354	Chemicals (fertilisers, pesticides, paint, drugs)	15,363	7.7
310,320,355,356	Food, Textiles, Plastics Production	61,630	30.8
3830,3832	Electrical Machinery (electronic, appliances)	18,959	9.5
3820,3825,3850	Machinery (industrial, office, instruments)	7,726	3.9
330,340,360,390	Other Manufacturing (wood, paper, concrete)	14,469	7.2
384	Transport equipment (railroad etc)	2,902	1.5
4000 - 7000	Infrastructure Services	21,222	10.6
8000 Except 8324	Financial, Software development Services	34,361	17.2
8324, 9000	Engineering, Scientific Services	12,074	6.0
1000 - 9000	Total	200,048	100.0

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

Table 10. TYPE OF R&D EXPENDITURE, BY INDUSTRY GROUP, 1989/90

Industry of Enterprise		Type of Expenditure, ($'000)			
NZSIC Code	Description	Wages and Salaries	Other Current Expenditure	Capital Expenditure	Total
1000,2000, 371,372,381	Agriculture, Forestry, Fishing,Mining, Basic Metals and Metal Fabrication	6,329	4,134	878	11,341
351,352,353,354	Chemicals (fertilisers, pesticides, paint, drugs)	9,810	4,052	1,50 1	15,363
310,320,355,356	Food, Textiles, Plastics Production	33,674	18,121	9,835	61,630
3830,3832	Electrical Machinery (electronic appliances)	12,701	4,341	1,917	18,959
382,384,385	Machinery (industrial, office,instruments), Transport equipment (railroad etc)	6,973	2,396	1,259	10,628
330,340,360,390	Other Manufacturing wood, paper, concrete)	7,144	6,026	1,299	14,469
4000 - 7000	Infrastructure Services	12,545	6,745	1,932	21,222
8000 Except 8324	Financial, Software Development Services	17,261	14,213	2,887	34,361
8324, 9000	Engineering, Scientific Services	7,811	3,572	691	12,074
100 - 9000	Total	114,248	63,599	22,200	200,048
	Percent of Total	57.1	31.8	11.1	100.0

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

12 Type of R&D expenditure

Enterprises were asked to indicate how they spent their funds on R&D. The results are given in Table 10.

Wages and salaries consumed 57 percent of the $200 million allocated to R&D in the business enterprise sector. Other current expenditure accounted for 32 percent and capital expenditure for the remaining 11 percent.

13 Intensity of R&D, by industry group

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

One indicator of R&D intensity is also given: the expenditure on R&D per full time equivalent R&D staff member. The statistics in this table can be combined with various other industry statistics, such as total exports and value of production, and trends in these figures, to develop science and technology indicators. This type of analysis will become more meaningful once the Ministry has completed and published the results of surveys of R&D expenditure and personnel in the Government and Higher Education Sectors.

14 Intramural R&D expenditure by science output class and by industry group

Table 12 shows the science output areas towards which the research of each industry group was directed.

Table 11. BROAD R&D INDICATORS, BY INDUSTRY GROUP, 1989/90

Industry of Enterprise					
NZSIC Code	Description	Enterprises undertaking R&D	R&D Expenditure ($'000)	R&D Personnel (FTE)	Expenditure Per (FTE)($'000)
1000	Agriculture, Forestry and Fishing	6	3,418	49	70
2000,371,372,381	Mining, Basic Metals and Metal Fabrication	76	7,923	97	82
351, 352,353,354	Chemicals (fertilisers, pesticides, paint, drugs)	108	15,363	240	64
310,320,355,356	Food, Textiles, Plastics Production	210	61,630	910	68
3830,3832	Electrical Machinery (electronic, appliances)	129	18,959	360	53
3820,3825,3850	Machinery (industrial, office, instruments)	55	7,726	127	61
330,340,360,390	Other Manufacturing (wood, paper, concrete)	97	14,469	146	99
384	Transport equipment (railroad etc)	23	2,902	29	100
4000 - 7000	Infrastructure Services	42	21,222	283	75
8000 Except 8324	Financial, Software development Services	174	34,361	379	91
8324, 9000	Engineering, Scientific Services	109	12,074	206	59
100 - 9000	Total	1,027	200,048	2,826	71

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

Table 12. INTRAMURAL BUSINESS ENTERPRISE R&D EXPENDITURE, BY INDUSTRY GROUP, BY SCIENCE OUTPUT CLASS, 1989/90

SCIENCE OUTPUT CLASS	INDUSTRY GROUP ($'000)											
	Agriculture	Mining, Metals	Chemicals, Drugs	Food, Textiles	Electricals, Electronic	Machinery	Other Manufacturing	Infrastructure Services	Financial, Software Services	Engineering, Scientific Services	Transport	Total
01 Sheep Production			1,108	625			514			28		2,248
02 Beef Production			239	292								550
03 Dairy Production		1,596		831			n.p.	n.p.		43		2,493
04 Alternative Animal Species			964	413			n.p.	n.p.				1,082
05 Generic Animal Research												334
06 Forage Plants			1,415							45		1,426
07 Horticulture		903		423			n.p.	753				2,017
08 Arable & other Plants			363	170			251					723
09 Plantation Forestry	2000		474							297		1,927
10 Fisheries												1,094
11 Meat Processing			723	8,470								8,897
12 Dairy Processing		157		25,017			n.p.	2,893		367		28,561
13 Other Food Processing				6,857			n.p.	1,381	n.p.			7,410
14 Fibre, Textiles & Skin Processing				10,976		830						12,361
15 Wood & Paper Processing		515		n.p.	n.p.		6,825			256		7,853
16 Materials & Industrial Processing		2,442	6,119	3,542	428		3,079	1,101		263		17,523
17 Engineering		3,083	391	1,864	5,841	2,221	679	549		1,557	714	16,889
18 Electronic & Instruments		n.p.		200	10,502	3,110	988	4,406	10,771	781		30,774
19 Construction		n.p.	n.p.	n.p.			204	n.p.		1,028		4,785
20 Commercial & Trade Services			n.p.	n.p.		1,386	n.p.	n.p.	2,709			4,735
21 Energy		n.p.	n.p.	n.p.	1,251		n.p.	1,738		485		5,549
22 Transport	n.p.	n.p.	n.p.	293	152		n.p.	n.p.		2,474		4,341
23 Information & Communication	n.p.			n.p.			819	n.p.	18,672			21,662
24 Urban & Rural Planning								n.p.		n.p.		518
25 History, Society & Culture								n.p.		n.p.		161
26 Relationships & Wellbeing										217		217
27 Political & Economic Relationships	n.p.									n.p.		1,830
28 Education, Knowledge & Training										76		76
29 Environment Protection			1336		669	n.p.		297		718		2,899
30 Geological Structures & Processes		n.p.					n.p.			1,075		2,061
31 Land use, Flora & Fauna												n.p.
32 Marine & Fresh Waters								n.p.		n.p.		649
33 Climate & Atmosphere										n.p.		n.p.
34 Space										n.p.		n.p.
35 Antarctica												n.p.
36 Fundamental Knowledge					n.p.	n.p.		n.p.		430		572
37 Health			1,464				706		2,297			4,466
38 Defence									n.p.			n.p.

Note:Columns will not always agree with totals shown due to rounding of individual estimates.
n.p. = not for publication due to confidentiality.

15 Extramural R&D, by industry group

Table 13 provides information about R&D funded by a business enterprise but carried out by other enterprises, institutions or individuals. A total of $77 million was spent on extramural R&D.

Organisations providing R&D for business enterprises included other business enterprises, who received a total of $44 million, of which $35 million went to an enterprise related to the funder; central government, which received $12 million; universities, who received $6 million, and overseas organisations. Of the total of $14 million spent on R&D carried out overseas, $12 million went to an overseas enterprise related to the funder.

The amount stated as spent with government is surprisingly low. This may be because those high tech firms too small to be able to afford their own R&D have been excluded by their small size from the sample criteria. Another reason is that much work that government science departments carry out includes consultancy rather than R&D according to the strict definitions applied in the survey.

Most of the funds spent on R&D undertaken by another organisation came from the wholesale trade sector, which includes the producer boards. Of the total of $49 million from this sector, $35.5 million was spent with local private sector enterprises, including the research associations, $5.2 million was spent in the government sector, and $7.6 million was spent overseas.

The chemical industry was the next largest source of funds for extramural R&D. This group spent less than one tenth of the amount spent by the wholesalers. Government and the Universities were the main providers to this industry group.

Of the remaining industry groups, the electrical industry was notable for the fact that 95 percent of extramural R&D funds were spent overseas, and agriculture for the fact that nothing at all was spent overseas. The metals and mining industry, food and primary product processing, and infrastructure services all showed a preference for private sector R&D providers while the transport equipment and other manufacturing and machinery group used government as well as private sector providers.

16 Estimate of total expenditure on R&D by the business enterprise sector, by output class

Total expenditure on R&D by the business enterprise sector includes R&D financed and carried out by the sector, and R&D paid for by the sector and carried out by government, other enterprises outside the business enterprise sector, or carried out overseas.

The estimate obtained from this survey was that a total of $208.8 million was spent on R&D by the business enterprise sector in 1989/90.

Table 14 was derived as follows: Table 6 shows that business enterprises carried out R&D in-house to the value of $176 million with their own funds or with funds from other business enterprises. Table 13 shows that business enterprises also funded R&D to the value of $33 million extramurally in other sectors (in the universities, government or overseas).

There was a difference between the total value of R&D that enterprises said they had carried out with funds from other enterprises ($34 million), and the total that funders said they paid to other business enterprises to provide R&D ($44 million). Providers responding to the survey are judging the R&D that they perform against the strict definitions provided, so their response is more likely to be correct.

To obtain the estimates in Table 14, funding from government and overseas was deducted proportionately from the value of intramural R&D in each output class. This provides intramural R&D funded solely by business enterprises, shown in column two.

Business financed extramural R&D carried out by universities, government or overseas had to be allocated to output classes, because the survey asked only for the total. This was done by assuming that most businesses will fund R&D for their own industry or for the same purpose as their internal R&D. The resulting estimates are shown in column three.

Table 13. EXTRAMURAL R&D FUNDED BY BUSINESS ENTERPRISES, 1989/90
By industry group

Industry of Enterprise		Number of Enterprises	Sector of Recipient of R&D Funding, ($'000)				Total ($'000)
NZSIC Code	Description		Government	University	Other Business Enterprises	Overseas Organization	
1000	Agriculture, Forestry, Fishing	6	273	n.p.	n.p.	n.p.	769
2000,371,372,381	Mining, Basic Metals and Metal Fabrication	13	113	n.p.	685		892
350, 352,353,354	Chemicals (fertilisers, pesticides, paint, drugs)	54	2,376	1,326	894	562	5,158
310,320,355,356	Food, Textiles, Plastics production	59	1,048	503	1,481	595	3,627
3830,3832	Electrical Machinery (electronic, appliances)	18	n.p.	n.p.	n.p.	3,889	4,098
330,340,360,382, 384,385,390	Machinery and Other Manufacturing, Transport Equipment	65	1,541	85	1,478	663	3,768
4000 - 8000 Except 6100,8324	Infrastructure (except Wholesale), Financial, Software Services	15	n.p.	348	2,917	n.p.	5,217
6100	Wholesale (includes Producer Boards)	19	5,150	768	35,514	7,564	48,996
8324, 9000	Engineering and Scientific Services	67	635	2,489	1,343		4,467
100 - 9000	Total	315	12,160	6,092	44,357	14,387	76,995

Note: Columns will not always agree with totals shown due to rounding of individual estimates. n.p. = not for publication due to confidentiality.

Table 14. BUSINESS ENTERPRISE INTRAMURAL AND EXTRAMURAL EXPENDITURE ON R&D, 1989/90

SCIENCE OUTPUT CLASS	INTRAMURAL R&D ($'000)	EXTRAMURAL R&D ($'000)	TOTAL R&D FUNDED BY BUSINESS ENTERPRISES
01 Sheep Production	2,180	1,594	3,774
02 Beef Production	536	157	693
03 Dairy Production	2,415	514	2,929
04 Alternative Animal Species	1,065	426	1,491
05 Generic Animal Research	330	346	676
06 Forage Plants	1,425	165	1,590
07 Horticulture	1,995	3,802	5,798
08 Arable & other Plants	712	233	946
09 Plantation Forestry	1,652	304	1,956
10 Fisheries	902	152	1,054
11 Meat Processing	7,325	775	8,100
12 Dairy Processing	26,725	3,619	30,344
13 Other Food Processing	7,406	1,341	8,747
14 Fibre, Textiles & Skin Processing	10,475	2,485	12,959
15 Wood & Paper Processing	7,784	2,794	10,578
16 Materials & Industrial Processing	16,333	1,751	18,085
17 Engineering	16,500	458	16,958
18 Electronic & Instruments	21,442	4,112	25,554
19 Construction	3,598	116	3,714
20 Commercial & Trade Services	4,159	155	4,314
21 Energy	4,888	2,181	7,069
22 Transport	4,162	888	5,049
23 Information & Communication	21,559	338	21,897
24 Urban & Rural Planning	409	113	523
25 History, Society & Culture	154	2	156
26 Relationships & Wellbeing	163	21	184
27 Political & Economic Relationships	980	24	1,004
28 Education, Knowledge & Training	75	1	76
29 Environment Protection	2,372	423	2,795
30 Geological Structures & Processes	1,385	40	1,425
31 Land use, Flora & Fauna	n.p.	n.p.	n.p.
32 Marine & Fresh Waters	316	20	336
33 Climate & Atmosphere	15	0	15
34 Space	47	6	53
35 Antarctica	0	0	0
36 Fundamental Knowledge	312	139	451
37 Health	3,822	3,146	6,968
38 Defence	n.p.	n.p.	n.p.
Total	176,141	32,638	208,779

Note: Columns will not always agree with totals shown due to rounding of individual estimates.
n.p. = not for publication due to confidentiality.

The final column is total expenditure on R&D by the business enterprise sector. Dairy processing is the largest single target of private sector R&D funds, with $30.3 million spent in New Zealand or overseas.

Output classes 18 (electronics and instruments), and 23 (information and communication services) should be considered together. The first represents 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 23 percent of private sector funding for R&D, and 26 percent of all research carried out in the private sector.

Materials and industrial processes ($18 million) and engineering processes ($17 million) are the next largest areas of business enterprise funding.

17 Technological balance of payments

The national balance of payments for international transactions relating to trade in technical know-how for the business enterprise sector was a surplus of $2.44 million.

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 paragraph 6.

The total cost of technical know-how purchased was $40.50 million, whilst income from sales was $42.94 million.

The main income earnings for New Zealand from the export of technical know-how were in the areas of computing and communications hardware and software.

Table 15. TECHNOLOGICAL BALANCE OF PAYMENTS FOR THE BUSINESS ENTERPRISE SECTOR, 1989/90

	($'000)
Receipts including those for software development (more than 27 million), and electronics, appliances and electrical and industrial machinery (more than $10 million)	$42,936
Payments including those made by utilities, telecommunications and industrial chemical enterprises	$40,496
Balance	$ 2,440

ANNEX 1 MEMBERS OF THE ADVISORY GROUP TO THE BUSINESS ENTERPRISE R&D SURVEY

1989/90		Area of Expertise
Dr David Bryant	General Manager, Scientific Services, Carter Holt Harvey	Building, Forestry Research
Mr Bevin Cornwall	Director, Auckland Industrial Development Division, DSIR	Electronics
Mr Larry Little	Director, Building Research Association of New Zealand	Building Research
Dr Kelly Mara	The Management Edge, Thorndon	Manufacturers' Federation R&D Survey
Mr John Robins	Manager, Philips Design and Development Laboratory	Information Technology
Dr George Stuart	Manager Research, Wool Board	Manufacturing/ Agricultural R&D
Dr Richard Stewart	Associate Dean Post-Graduate Affairs & Associate Professor of Surgery, Wellington School of Medicine	Health Research
Department of Statistics:		
Mr David Archer	Senior Manager	Economic and Business Surveys
Mr Geoff Mead	Senior Research Officer	Economic and Business Surveys
Mr Roger Parkes	Senior Survey Officer	R&D Surveys
Ministry of Research, Science and Technology:		
Dr Margriet Theron	Manager, Science Review (Chair)	Science Management
Dr Andrew West	Manager, Policy	Science Policy
Mr Mike Doig	Manager, Priorities and Funding	Science Funding
Ms Pamela Walker	Science Resource Analyst	Statistics (Convener)

Changes to the Membership:

Due to other heavy work commitments, Mr Bevin Cornwall resigned at the end of 1990.

Dr Richard Stewart died in December 1990. We were very fortunate to have had the benefit of his expert contribution to the survey.

New members 1990/91:

Mr William Howie	Director, Aoraki Corporation Ltd	Computer Software R&D
Dr John Smart	Head of Applied Biochemistry, NZ Dairy Research Institute	Dairy Research

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

29 New and improved 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

ANNEX 3 NEW ZEALAND STANDARD INDUSTRIAL CLASSIFICATION

Arranged 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.	382 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) and Producer Boards	61
	Transport, Storage	71
	Communication	72
FINANCIAL, SOFTWARE SERVICES	Business and Financial services (trading banks)	8 except 8323,8324
	Computer Bureaux and Consultancy,Software development	8323
ENGINEERING, SCIENTIFIC	Community, Social and Personal Services including Research and Scientific Institutes, Charities, Local Authorities	9
	Engineering, Architectural and Technical Services	8324