Research and Development in New Zealand:
2012

Research and development activity, employment, and expenditure in New Zealand
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1 Purpose of this report

*Research and Development in New Zealand: 2012* presents a statistical picture of research and development (R&D) in New Zealand in 2012. The information in this report is based on data from the R&D Survey 2012, which was conducted by Statistics NZ and funded by the Ministry of Business, Innovation and Employment.

R&D is important for economic growth and for sustaining a dynamic New Zealand economy. It is also vital in addressing the socio-economic issues unique to New Zealand. The R&D Survey is run every two years. Statistics from the survey measure and evaluate New Zealand’s R&D performance. These statistics also provide a basis for benchmarking this performance against other countries.

The R&D Survey 2012 collected information on business, government, and higher education (university) spending on R&D. Initial results from the survey were published in an information release on 27 March 2013 (see *Research and Development Survey: 2012* on the Statistics NZ website [www.stats.govt.nz](http://www.stats.govt.nz)). This report contains more detailed results from the survey.

The 2012 survey included a design change from the previous one. We sent questionnaires only to businesses that we believed to be undertaking R&D. While we adjusted 2010 results to be comparable, care is needed when interpreting the results.

Statistics NZ and the Ministry of Business, Innovation and Employment are grateful to the organisations that took part in the R&D Survey 2012.
2 Guide to interpreting the data

This chapter gives you the important information you should know when interpreting data from the R&D Survey 2012. Please consider this information when analysing the results. You will find a full technical description of the survey in chapter 13, 'Data quality'.

Percentage changes
Percentage movements are calculated using published data and are rounded to the nearest whole percent. This rounding can result in the sum of components not being equal to totals.

Rounding procedures
On occasion, figures are rounded to the nearest thousand or some other convenient unit. This rounding may result in a total disagreeing with the total of the individual items as shown in tables. Where figures are rounded, the unit is in general expressed in words below the table headings, but where space doesn’t allow this, the unit may be shown as (000) for thousands, etc.

All counts of businesses in this report were randomly rounded to base 3 to protect the confidentiality of respondents. For this reason, not all figures will sum to stated totals.

Source
Statistics NZ compiles all data, except where otherwise stated. Survey data has been used in this report.

Dollar values
All dollar values in this report are exclusive of GST.

More detail
For more information about the data, see chapter 13, ‘Data quality’.

Background to the Research and Development Survey
The R&D Survey 2012 was run by Statistics NZ jointly with the Ministry of Business, Innovation and Employment (MBIE). The R&D Survey measures the level of research and development activity, employment, and expenditure in the business, government, and higher education (university) sectors.

Comparing 2010 and 2012 results
The R&D Survey 2012 had a change in the target population from 'all economically significant enterprises that perform or fund R&D in New Zealand' in 2010 to 'all economically significant enterprises that have been pre-identified as performing or funding R&D activities in New Zealand' in 2012.

The changes have caused a break in the time series, so 2012 results should not be compared directly with previous results. For this report we used 2010 adjusted results modelled on the 2012 population criteria to allow for a better comparison to 2012 results. Care should be taken in interpreting the adjusted 2010 results. For more information on the changes see chapter 13, ‘Data quality’.
Definition of research and development

Statistics NZ uses the following definition of R&D, which is based on the Organisation for Economic Co-operation and Development’s (OECD) guidelines for international best practice: “Research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge. Any activity classified as R&D is characterised by originality. Investigation is a primary objective.”

Data collection

The R&D Survey 2012 was primarily conducted as a postal survey. The business, government, and Crown research institute questionnaires were posted out in August 2012 to collect information on the 2011/12 financial year. The university questionnaires were also sent in August 2012, and collected information for the year ended December 2011.

The university questionnaire was designed to allow universities to use financial information that is generally produced for annual reporting. This means a number of data items for universities’ R&D were produced using modelled information. Universities New Zealand – Te Pōkai Tara and MBIE assisted Statistics NZ in determining these modelling specifications. Information collected included university discretionary income, internal and external research funding, academic staff salaries, university operating expenditure by faculty, and R&D personnel data.

Nature of the survey

Given the nature of the data collected, there are limitations on the level of accuracy that can be expected from the R&D Survey. Many respondents do not keep separate accounts of their R&D expenditure, or they may include R&D with other scientific and technological services, such as consulting. Records may not be kept in the form required for the survey and estimation may be required.

Detailed descriptions of what should and should not be included as R&D were provided on the questionnaire, and phone-in help was available to respondents.

Published sector and industry breakdowns

Published results have been created using classifications and frameworks recommended by the Frascati manual 2002 (Organisation for Economic Co-operation and Development [OECD], 2002) to allow for international comparability with other OECD member country surveys.

Full details of sector and industry breakdowns are provided in chapter 13, ‘Data quality’.

Business sector

State-owned enterprises and private not-for-profit organisations are included in this sector. Universities’ commercial arms are included in the higher education sector.

Government sector

The government sector includes New Zealand central government ministries and departments, Crown entities (including the Crown research institutes), Crown-owned companies, government funding agencies, and local government organisations. The government sector does not include State-owned enterprises. These are included in the business sector.
Higher education sector

Information about New Zealand’s higher-education expenditure on R&D (HERD) in this report is based only on universities and their commercial arms. Investigations have shown that universities perform the majority of R&D in this sector in New Zealand. This may differ from other OECD countries and should be noted in any international comparisons.

Commercial arms have been included under the higher education sector from 2010 onwards. Previously, these were included in the business sector. The additional expenditure contributed by including commercial arms is not significant in comparison to overall HERD.
3 Expenditure on research and development

This chapter gives an overview of total R&D expenditure for 2012. It includes a comparison of results from 2006 to 2012, sector-level analysis, and R&D expenditure as a proportion of gross domestic product (GDP).

Sector-level analysis is discussed throughout this report. See the previous chapter ‘Guide to interpreting the data’ for sector definitions.

Gross expenditure on research and development

The increasing trend in overall R&D expenditure has continued into 2012 (see figure 3.01). Total R&D expenditure for 2012 was up 10 percent from 2010, exceeding $2.6 billion for the first time.

Figure 3.01

Gross expenditure on research and development
2006–12

$\text{(billion)}$

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>2.0</td>
<td>2.5</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand

Sector activity

In 2012, growth in business R&D activity has seen the business sector spend more than $1 billion on R&D for the first time (up 23 percent from 2010 to reach $1.2 billion). This amount is almost half of total R&D expenditure for the year.

Government spending on R&D decreased 3 percent from 2010, while the higher education sector spending increased 4 percent.

Table 3.01 presents gross expenditure on R&D by sector for the period 2006–12.
Table 3.01

Gross expenditure on research and development
By sector
2006–12

<table>
<thead>
<tr>
<th>Sector</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$(million)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>760</td>
<td>923</td>
<td>971</td>
<td>1,193</td>
</tr>
<tr>
<td>Government</td>
<td>473</td>
<td>584</td>
<td>615</td>
<td>R 596</td>
</tr>
<tr>
<td>Higher education (universities)</td>
<td>593</td>
<td>653</td>
<td>802</td>
<td>836</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,826</strong></td>
<td><strong>2,161</strong></td>
<td><strong>2,388</strong></td>
<td><strong>R 2,625</strong></td>
</tr>
</tbody>
</table>

**Note:** Due to rounding, some figures may not add to stated totals.

**Symbol:**
R revised

**Source:** Statistics New Zealand

Breaking down the business sector by broad industry (primary, manufacturing, services) enables us to assess the sector’s performance in more detail. In 2012, the manufacturing industry had the largest increase in dollar terms for R&D expenditure (up $96 million from 2010). However, the primary industry had the largest percentage increase, up 74 percent from 2010.

Figure 3.02 shows gross expenditure on R&D by the primary, manufacturing, and service industries.

**Figure 3.02**

![Research and development expenditure by industry](image_url)
Research and development as a proportion of gross domestic product

Calculating R&D expenditure as a proportion of gross domestic product (GDP) is a common way of measuring R&D activity. It can serve as a performance measure for New Zealand’s economy or as a means to compare R&D activity with those of other countries (see chapter 12 for more detail on international comparisons).

In 2012, total R&D expenditure in New Zealand as a proportion of GDP increased only slightly from 2010, to 1.27 percent of GDP. The estimated current price GDP for New Zealand for the year ended December 2012 was $206 billion (Statistics NZ, 2012), up 8 percent from 2010. This increase offset the increase in total R&D expenditure. However, sector proportions have changed, with the business sector the only sector to increase its proportion of GDP.

Table 3.02 shows business sector R&D as a proportion of GDP increased from 0.51 percent in 2010 to 0.58 percent in 2012. This is a positive result considering the following statement from MBIE: “An increase in business expenditure on research and development with a long term aim of this increasing to at least 1 percent of GDP” (MBIE, 2013).

<table>
<thead>
<tr>
<th>Sector</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>0.51</td>
<td>0.58</td>
</tr>
<tr>
<td>Government</td>
<td>0.32</td>
<td>0.29</td>
</tr>
<tr>
<td>Higher education (universities)</td>
<td>0.42</td>
<td>0.41</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.26</td>
<td>1.27</td>
</tr>
</tbody>
</table>

**Note**: Due to rounding, some figures may not add to stated totals.

**Symbol**:
- R revised
- P provisional

**Source**: Statistics New Zealand
This chapter presents the sources of funding for R&D expenditure. These sources include businesses, government, universities, overseas organisations, and other groups such as charities or lottery boards.

Figure 4.01 shows the sources of R&D funding in 2010 and 2012.

New Zealand businesses and government are the primary sources of R&D funding in New Zealand, contributing over 80 percent of the total. In 2012, they contributed 41 and 40 percent of the total funds, respectively, with other funding sources making up the balance, ranging from 3 to 9 percent each.

Except for government, funding from all sources increased from 2010.

**Sector activity**

Transfer of R&D funds between sectors is common in New Zealand. Collaboration among the sectors is a key characteristic of New Zealand’s R&D environment. The sharing of skills, knowledge, and resources enables a dynamic environment for ideas to flourish.

Linking the source of funds to the recipient sector enables us to track the flow of money across sectors and between years. This enables us to identify where the funding is ending up and may help us find emerging trends.

Even though government funding decreased overall, its funding contribution to the business sector rose significantly in 2012, up 78 percent from 2010. This increase helped to push business R&D expenditure above the $1 billion mark.
From table 4.01 we can also see that the flow of funds in the reverse direction also increased. New Zealand businesses increased their funding for government R&D projects by 17 percent, to reach $105 million in 2012.

The higher education sector received $508 million or 61 percent of their funding from the government in 2012, down slightly from 65 percent in 2010. The higher education sector’s proportion of self-funding increased however, from 24 to 28 percent, which helped boost its overall R&D expenditure.

Table 4.01 shows the funding levels split across the sectors by source. It also shows the figures for the last two reference years to enable calculation of changes in funding level across time.

**Table 4.01**

**Source of funds for research and development**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>780</td>
<td>911</td>
<td>90</td>
<td>R 105</td>
<td>42</td>
<td>34</td>
</tr>
<tr>
<td>Government</td>
<td>82</td>
<td>146</td>
<td>483</td>
<td>R 432</td>
<td>519</td>
<td>508</td>
</tr>
<tr>
<td>Higher education</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>191</td>
<td>238</td>
</tr>
<tr>
<td>New Zealand business</td>
<td>913</td>
<td>R 1,049</td>
<td>R 42</td>
<td>34</td>
<td>90</td>
<td>R 105</td>
</tr>
<tr>
<td>New Zealand government</td>
<td>1,083</td>
<td>R 1,087</td>
<td>R 42</td>
<td>34</td>
<td>82</td>
<td>146</td>
</tr>
<tr>
<td>New Zealand universities</td>
<td>201</td>
<td>R 249</td>
<td>191</td>
<td>238</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Overseas</td>
<td>122</td>
<td>R 166</td>
<td>24</td>
<td>29</td>
<td>81</td>
<td>106</td>
</tr>
<tr>
<td>Other funding sources</td>
<td>68</td>
<td>R 73</td>
<td>27</td>
<td>27</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Total</td>
<td>971</td>
<td>1,193</td>
<td>615</td>
<td>R 596</td>
<td>802</td>
<td>836</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,388</strong></td>
<td><strong>2,625</strong></td>
<td><strong>836</strong></td>
<td><strong>836</strong></td>
<td><strong>836</strong></td>
<td><strong>836</strong></td>
</tr>
</tbody>
</table>

1. Includes New Zealand local government agencies.

**Note:** Due to rounding, some figures may not add to stated totals.

**Symbol:**
- C confidential
- R revised

**Source:** Statistics New Zealand
This chapter details how R&D expenditure was spent in terms of current and capital items. It includes a comparison of results from 2006 to 2012 and sector-level analysis.

The money spent by an organisation for R&D can be split into current and capital expenditure. Current expenditure includes salaries and wages of staff directly supporting R&D activity, and other costs such as consumables and overheads incurred. Capital expenditure includes expenditure on land, buildings, plant, and machinery used for R&D. More detail on the expenditure categories can be found in chapter 13 ‘Data quality’.

In dollar terms, all expenditure types have increased since 2010. However, as a proportion of total expenditure, wages and salaries decreased slightly, other current expenditure remained the same, and capital expenditure increased slightly.

Table 5.01 shows expenditure by type since 2006. There has been little change in the proportional make-up of total expenditure across the years. Of total expenditure, wages and salaries were above 50 percent, other current expenditure at just below 40 percent, and capital expenditure at around 10 percent. R&D is a manually intensive activity so it is not surprising that labour costs far outweigh capital expenses.

### Table 5.01

#### Current and capital expenditure on research and development

<table>
<thead>
<tr>
<th>Type of expenditure</th>
<th>2006 (in thousands)</th>
<th>2008 (in thousands)</th>
<th>2010 (in thousands)</th>
<th>2012 (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$(million)</td>
<td>Percent of total</td>
<td>$(million)</td>
<td>Percent of total</td>
</tr>
<tr>
<td>Wages and salaries</td>
<td>922</td>
<td>51</td>
<td>1,134</td>
<td>52</td>
</tr>
<tr>
<td>Other current expenditure</td>
<td>718</td>
<td>39</td>
<td>834</td>
<td>39</td>
</tr>
<tr>
<td>Capital expenditure</td>
<td>185</td>
<td>10</td>
<td>193</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,826</strong></td>
<td><strong>100</strong></td>
<td><strong>2,161</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Note:** Due to rounding, some figures may not add to stated totals.

**Symbol:**

R revised

**Source:** Statistics New Zealand

### Sector activity

In 2012, the business sector increased its spending on wages and salaries by $64 million, up 12 percent from 2010. Capital spending on plant and machinery by businesses increased by a similar amount ($65 million). However, as a percent this amount represented a much larger increase – up 163 percent since 2010.

Government spending on wages and salaries remained the same. Overall, capital expenditure by government decreased 11 percent and other current expenditure decreased 5 percent.

The higher education sector showed rises in both capital expenditure on land and buildings (up 61 percent) and other current expenditure (up 6 percent). There was a slight decrease in wages and salaries, down 1 percent from 2010.
Table 5.02 shows current and capital expenditure in terms of dollar values for each sector in 2010 and 2012.

### Table 5.02

**Current and capital expenditure on research and development**  
By sector  
2010 and 2012

<table>
<thead>
<tr>
<th>Type of expenditure</th>
<th>Recipient sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business</td>
<td>Government</td>
</tr>
<tr>
<td>Wages and salaries</td>
<td>551 R</td>
<td>615</td>
</tr>
<tr>
<td>Other current expenditure</td>
<td>370 R</td>
<td>462</td>
</tr>
<tr>
<td>Capital expenditure</td>
<td>49</td>
<td>116</td>
</tr>
<tr>
<td>Land and buildings</td>
<td>10 R</td>
<td>12</td>
</tr>
<tr>
<td>Plant and machinery</td>
<td>40 R</td>
<td>105</td>
</tr>
<tr>
<td>Total</td>
<td>971</td>
<td>1,193</td>
</tr>
</tbody>
</table>

**Note:** Due to rounding, some figures may not add to stated totals.

**Symbol:**

R revised

**Source:** Statistics New Zealand
6 Type of research

This chapter details R&D expenditure in terms of the type of research it was spent on. It includes a comparison of results from 2006 to 2012 and sector-level analysis.

Gross R&D expenditure is split into three main types of activity, based on Frascati manual 2002 (OECD, 2002) definitions:

- basic research is carried out for the advancement of knowledge
- applied research is acquiring new knowledge for a specific aim
- experimental development draws on existing knowledge to produce new or altered materials, products, and devices.

For the government and higher education sectors, basic research is broken down further into pure basic research and targeted basic research. For definitions of the types of R&D, see chapter 13 ‘Data quality’.

Table 6.01 shows increases across all types of R&D expenditure from 2006 to 2012. Expenditure on applied research showed the largest increase, exceeding $1 billion for the first time and making up 41 percent of total R&D expenditure in 2012. In 2006 there was an even representation of the three types of R&D. However, in recent years, spending on basic research decreased in proportion to the total, while that for applied research increased. This change may be due to increased growth in business R&D compared with the higher education sector. Expenditure on experimental development has remained relatively steady, making up one-third of total R&D expenditure in 2012.

Table 6.01

Expenditure on research and development
By type of research
2006–12

<table>
<thead>
<tr>
<th>Type of R&amp;D</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(million)</td>
<td>Percent of total</td>
<td>(million)</td>
<td>Percent of total</td>
</tr>
<tr>
<td>Basic research</td>
<td>551</td>
<td>30</td>
<td>653</td>
<td>30</td>
</tr>
<tr>
<td>Applied research</td>
<td>647</td>
<td>35</td>
<td>741</td>
<td>34</td>
</tr>
<tr>
<td>Experimental development</td>
<td>628</td>
<td>34</td>
<td>767</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>1,826</td>
<td>100</td>
<td>2,161</td>
<td>100</td>
</tr>
</tbody>
</table>

1. Basic research is an aggregate of the basic research category in the business sector, and the pure basic and targeted basic research types in the government and higher education sectors.

Note: Due to rounding, some figures may not add to stated totals.

Symbol:
R revised

Source: Statistics New Zealand
Sector activity

Applied research and experimental development are the more commercially focused types of R&D. For instance, spending on applied research and experimental development is higher in the business sector. This compares with the higher education sector, which contributed over 60 percent to total expenditure on basic research in 2012.

Table 6.02 shows the business sector increased its expenditure on all types of R&D since 2010. It drove the large increase in expenditure on applied research with an additional $136 million from 2010.

Table 6.02
Expenditure on research and development
By type of research and sector
2010 and 2012

<table>
<thead>
<tr>
<th>Type of R&amp;D</th>
<th>Recipient sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business</td>
<td>Government</td>
</tr>
<tr>
<td>Basic(1) research</td>
<td>54</td>
<td>71</td>
</tr>
<tr>
<td>Applied research</td>
<td>300</td>
<td>436</td>
</tr>
<tr>
<td>Experimental development</td>
<td>617</td>
<td>686</td>
</tr>
<tr>
<td>Total</td>
<td>971</td>
<td>1,193</td>
</tr>
</tbody>
</table>

1. Basic research is an aggregate of the basic research category in the business sector, and the pure basic and targeted basic research types in the government and higher education sectors.

Note: Due to rounding, some figures may not add to stated totals.

Symbol:
R revised

Source: Statistics New Zealand
This chapter details expenditure on R&D in terms of its purpose. It compares socio-economic objectives for 2010 and 2012.

New Zealand’s R&D expenditure can be broken down by purpose. This breakdown shows the main socio-economic objective of and the areas of the economy that will benefit from R&D.

Manufacturing remains to be the main purpose of R&D. Results from the 2012 survey showed that 20 percent of total R&D expenditure was for manufacturing purposes. Primary industry comes second at 17 percent. The proportion of each objective to the total was stable across 2010–12 with no significant fluctuations. The overall increase in R&D expenditure was evenly distributed across all objectives, with most showing increases in dollar terms except for economic framework, environment, and knowledge (see table 7.01).

**Table 7.01**

**Expenditure on research and development**

*By socio-economic objective*  
*2010 and 2012*

<table>
<thead>
<tr>
<th>Socio-economic objective</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$(million)</td>
<td>Percent of total</td>
</tr>
<tr>
<td>Primary industries</td>
<td>389 R 16 R</td>
<td>457 17</td>
</tr>
<tr>
<td>Energy</td>
<td>95 4</td>
<td>113 4</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>449 R 19 R</td>
<td>530 20</td>
</tr>
<tr>
<td>Construction and transport</td>
<td>124 5</td>
<td>129 5</td>
</tr>
<tr>
<td>Information and communication services</td>
<td>225 9</td>
<td>244 9</td>
</tr>
<tr>
<td>Commercial services and tourism</td>
<td>46 2</td>
<td>69 3</td>
</tr>
<tr>
<td>Health</td>
<td>313 13</td>
<td>317 12</td>
</tr>
<tr>
<td>Education and training</td>
<td>102 4</td>
<td>114 4</td>
</tr>
<tr>
<td>Law, politics, and community services</td>
<td>41 2</td>
<td>55 2</td>
</tr>
<tr>
<td>Cultural understanding</td>
<td>77 3</td>
<td>87 3</td>
</tr>
<tr>
<td>Economic framework</td>
<td>54 2</td>
<td>39 1</td>
</tr>
<tr>
<td>Environment</td>
<td>283 R 12 R</td>
<td>264 10</td>
</tr>
<tr>
<td>Other(1)</td>
<td>81 3</td>
<td>99 4</td>
</tr>
<tr>
<td>Knowledge – general(2)</td>
<td>109 5</td>
<td>107 4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,388 R 100</strong></td>
<td><strong>2,625 100</strong></td>
</tr>
</tbody>
</table>

1. Includes defence and other research purposes.
2. Research undertaken by universities that does not relate to a specific area of purpose.

**Note**: Due to rounding, some figures may not add to stated totals.

**Symbol**:

- R revised

**Source**: Statistics New Zealand
Researchers, technicians, and support staff

This chapter provides information on R&D personnel by occupation group (researchers, technicians, and support staff). This information was collected on both a headcount and full-time equivalent (FTE) basis. For this report, we will focus on FTEs as they represent a standardised unit of measure (see figure 8.02 for a comparison between these two personnel measures in the form of a ratio). The relationship between FTEs and headcounts is explained in chapter 13 'Data quality'.

Researchers are staff that create new knowledge or products, those involved in planning and managing R&D projects, and software developers. Technicians are staff engaged in technical tasks in support of R&D. Support staff include administrative and managerial staff providing direct support to an R&D activity.

Table 8.01 shows there is a consistent increasing trend in R&D FTEs since 2006. The number of FTEs was 28,400 in 2012, up 5,300 from 2006. Researchers are the largest occupation group and are responsible for over 70 percent of this increase. They made up 75 percent of total FTEs in 2012.

Table 8.01
Personnel involved in research and development
Full-time equivalents (FTEs) by occupation 2006–12

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTEs</td>
<td>Percent of total</td>
<td>FTEs</td>
<td>Percent of total</td>
</tr>
<tr>
<td>Researcher</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student researcher</td>
<td>8,500</td>
<td>37</td>
<td>10,000</td>
<td>40</td>
</tr>
<tr>
<td>Total researchers</td>
<td>17,200</td>
<td>74</td>
<td>18,300</td>
<td>74</td>
</tr>
<tr>
<td>Technician</td>
<td>3,200</td>
<td>14</td>
<td>3,800</td>
<td>15</td>
</tr>
<tr>
<td>Support staff</td>
<td>2,800</td>
<td>12</td>
<td>2,700</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>23,100</td>
<td>100</td>
<td>24,700</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: Due to rounding, some figures may not add to stated totals.

Symbol:
R revised

Source: Statistics New Zealand

Sector activity

Of the three sectors, higher education had the most researchers, with 14,100 FTEs in 2012. However, nearly 80 percent of these are student researchers and are typically post-graduate, master’s, or PhD students completing their thesis. Removing these students from the total number of FTEs involved in R&D would make the business sector the largest employer of FTEs (8,800 compared with 5,200 for the higher education sector).

Figure 8.01 shows FTEs by occupation and sector for 2010 and 2012.
Headcount to full-time equivalent ratio

The FTE to headcount ratio shows how much time staff are spending on carrying out R&D activities compared with non-R&D activities. For example, if a researcher spent half their time on R&D and the other half on other activities, they would represent 1 headcount but only 0.5 FTEs.

Figure 8.02 shows that government staff involved in R&D spent the most time on R&D compared with staff from other sectors. Most of these government staff are from Crown research institutes (CRIs), which are research-intensive in nature. The higher education sector has more staff engaged in duties outside R&D, such as lecturing.
Wage analysis

The R&D Survey collects information on wages and number of FTEs involved in R&D. Dividing one by the other gives us an implicit annual salary rate. This rate can be calculated across industries and sectors.

In 2012, of all FTEs involved in R&D, those in the metal product manufacturing industry had the highest pay rate, at just above $92,000 for each FTE. This was followed by the higher education sector (minus student FTEs) at almost $89,000. The lowest was textile and clothing manufacturing at just below $43,000.

In June 2012, according to the Quarterly Employment Survey (QES), the average national wage on an annual FTE basis was $54,000 (Statistics NZ, 2012a). Some industries are not surveyed as part of the QES, including the agriculture and aquaculture industries. A complete list of excluded industries can be found in the data quality section of the QES survey.

Figure 8.03 shows the average wage/salary rate in 2012 for each FTE involved in R&D.

**Figure 8.03**

Annual wages per full-time equivalent involved in research and development
By specific sector
2012

Source: Statistics New Zealand
This chapter reports on the highest qualification of R&D personnel. The qualifications are grouped into PhD, bachelor’s degree, technical and trade, and other qualifications. It includes a comparison of results from 2006 to 2012 and sector-level analysis.

Table 9.01 shows the number and proportion of personnel involved in R&D by their highest qualification, for the period 2006–12.

Table 9.01
Personnel involved in research and development
By highest qualification of full-time equivalents (FTEs)
2006–12

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTEs</td>
<td>Percent of total</td>
<td>FTEs</td>
<td>Percent of total</td>
</tr>
<tr>
<td>PhD</td>
<td>3,600</td>
<td>16</td>
<td>4,000</td>
<td>16</td>
</tr>
<tr>
<td>Bachelor's degree / postgraduate(1)</td>
<td>14,700</td>
<td>63</td>
<td>16,400</td>
<td>65</td>
</tr>
<tr>
<td>Technical and trade(2)</td>
<td>1,700</td>
<td>7</td>
<td>2,200</td>
<td>9</td>
</tr>
<tr>
<td>Other qualification</td>
<td>3,200</td>
<td>14</td>
<td>2,300</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>23,100</td>
<td>100</td>
<td>24,700</td>
<td>100</td>
</tr>
</tbody>
</table>

1. Bachelor’s degree or equivalent, and postgraduate qualifications other than PhD.
2. Technical and trade qualifications, eg New Zealand Certificate of Engineering or Science, or New Zealand Trade Certificate.

Note: Due to rounding, some figures may not add to stated totals.

Symbol:
R revised

Source: Statistics New Zealand

Of all staff involved in R&D, almost 85 percent have a bachelor’s degree or higher qualification. At the national level, however, less than 25 percent of wage and salary earners have a bachelor’s degree or higher (Statistics NZ, 2012b). This shows personnel involved in R&D activity tend to be very highly qualified.

Sector activity

In 2012, the business sector showed increases across all qualification groups. The number of FTEs with bachelor’s and post-graduate degrees increased the most, with over 800 additional FTEs from 2010.

Figure 9.01 shows the number of FTEs by highest qualification and sector for 2010 and 2012.
Figure 9.01

Full-time equivalents involved in research and development
By highest qualification and sector
2010 and 2012

Qualification

- PhD 2012
- PhD 2010
- Bachelor's degree/postgraduate 2012
- Bachelor's degree/postgraduate 2010
- Technical/trade 2012
- Technical/trade 2010
- Other 2012
- Other 2010

0 5 10 15 20

(000)

- Higher education
- Government
- Business

1. Bachelor's degree or equivalent, and postgraduate qualifications other than PhD.
2. Technical and trade qualifications, eg New Zealand Certificate of Engineering or Science, or New Zealand Trade Certificate.

Source: Statistics New Zealand
This chapter presents information specifically on bioscience R&D. It includes information on the percentage of R&D performers undertaking bioscience and their expenditure on bioscience R&D. Comparisons between 2012 and 2010 are made.

Expenditure and organisations involved

Bioscience is the development and application of knowledge of the way plants, animals, and humans function for the development of products and services.

In 2012, almost $500 million of total R&D expenditure was attributable to bioscience. This number is $10 million lower from 2010.

The government sector continued to spend the most ($202 million) on bioscience R&D despite its expenditure falling $20 million from 2010.

The business sector increased its spending on bioscience R&D, up from $90 million in 2010 to $111 million in 2012. The higher education sector spent $182 million on bioscience R&D, down from $193 million in 2010.

The overall number of organisations undertaking bioscience R&D remained steady compared with the overall number of R&D performers. Within the government sector, the proportion of bioscience R&D performers increased in contrast with the business and higher education sectors, which both fell.

Table 10.01 presents information on the percentage of R&D performers undertaking bioscience and expenditure on bioscience R&D.

Table 10.01

<table>
<thead>
<tr>
<th>Industry</th>
<th>R&amp;D performers 10.01</th>
<th>Total R&amp;D expenditure on bioscience 10.01</th>
<th>Overall R&amp;D spend attributable to bioscience 10.01</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent $1000 million</td>
<td>$1000 million</td>
<td>Percent $1000 million</td>
</tr>
<tr>
<td>Total business sector</td>
<td>11 18</td>
<td>90 111</td>
<td>9 9</td>
</tr>
<tr>
<td>Primary</td>
<td>21 24</td>
<td>22 36</td>
<td>31 30</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13 10</td>
<td>41 46</td>
<td>9 9</td>
</tr>
<tr>
<td>Services</td>
<td>8 8</td>
<td>26 26</td>
<td>6 5</td>
</tr>
<tr>
<td>Total government sector</td>
<td>20 28</td>
<td>222 202</td>
<td>58 R 34</td>
</tr>
<tr>
<td>(excluding higher education)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total higher education sector</td>
<td>100 85</td>
<td>193 182</td>
<td>24 22</td>
</tr>
<tr>
<td>Total for all sectors</td>
<td>11 11</td>
<td>595 R 495</td>
<td>21 R 19</td>
</tr>
</tbody>
</table>

1. R&D performers are those businesses either carrying out or funding R&D.
2. Percentage of total R&D performers
3. Should not be compared with expenditure figures from the Bioscience Survey 2011. See the data quality section for more detail.

Symbol: R - revised
Source: Statistics New Zealand
Bioscience is also applied outside of R&D. While these wider applications are not covered by the R&D Survey, you can get additional information from the Bioscience Survey. Differences between the two surveys mean that while figures are not directly comparable, they can be used in conjunction to form a more detailed picture of bioscience in New Zealand.
This chapter focuses on business R&D. It covers information on business engagement with CRIs and universities, the expected break-even time on R&D investment, and what businesses would spend more time and money on if they had the available resource.

Expectations, engagement, and expansion

In 2012 we collected new information from businesses undertaking R&D. This information included their motivations for investing in R&D and the expected returns from these investments. This new information will add to the information we previously collected on business engagement with CRIs and universities.

The main reason businesses undertook R&D was to gain entry into new markets. This reason was reported by over one-third of businesses, compared with one-quarter that said they wanted to maintain their position in the market (Statistics NZ, 2012c).

Businesses often engage with CRIs and universities for R&D. The most common way of engagement was between staff members, followed by contracted R&D activity funded by the business or a third party.

Table 11.01 shows the percentage of businesses surveyed that engage with CRIs and/or universities.

**Table 11.01**
**Business engagement with CRIs and universities**

<table>
<thead>
<tr>
<th>Type of engagement</th>
<th>CRIs</th>
<th>Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contracted R&amp;D funded by this organisation</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Contracted R&amp;D funded by this organisation and others</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Contact arranged (eg by Tech NZ, Research for Industry, New Zealand Trade and Enterprise) as part of government-funded R&amp;D</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Contact arranged through research consortia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Contact arranged through economic development agencies</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Contact arranged through business incubators</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Contact made through networking events</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Professional contacts between staff members</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

1. Engagement for R&D purposes.

**Note**: CRI = Crown research institute

**Source**: Statistics New Zealand

Of businesses that responded to the R&D survey in 2012, half did not engage with a CRI or university as expertise was not required. In other cases engagement was hindered or not possible due to communication issues, lack of expertise, and costs (11 percent each). Contractual reasons also hindered engagement but to a lesser extent. The proportion of businesses that reported ‘other’ reasons for not engaging with CRIs and universities was 17 percent.
Table 11.02 shows the percentage of businesses surveyed who did not engage with CRIs or universities.

Table 11.02
Reasons why businesses did not engage with CRIs or universities
2012

<table>
<thead>
<tr>
<th>Reason for not engaging</th>
<th>Percent(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input or expertise not needed</td>
<td>50</td>
</tr>
<tr>
<td>Did not know how to make contact</td>
<td>11</td>
</tr>
<tr>
<td>Did not have the expertise required</td>
<td>11</td>
</tr>
<tr>
<td>Costs too high</td>
<td>11</td>
</tr>
<tr>
<td>Contractual difficulties</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
</tr>
</tbody>
</table>

1. Percentage of all business sector respondents

**Note**: CRI = Crown research institute

**Source**: Statistics New Zealand

In 2012 we asked businesses for the first time about their expected return on R&D investment. Almost all businesses expected to break even within five years.

On their R&D activity for the next year, 38 percent of businesses that carried out R&D said the level of activity would stay the same. A similar proportion said this will increase.

Figure 11.01 shows the relationship between the likelihood of undertaking R&D in the future and the expected break-even time on that investment. Not surprisingly, as time taken to break even on R&D investment increases, firms are less likely to increase their level of R&D. Businesses in the primary industries take a lot longer to break even. For example, the mining industry is capital intensive in nature and is characterised by exploration. This means it can take longer to recoup their initial R&D investment.
Spending on R&D can be costly for businesses constrained by resources. We added new questions to the 2012 questionnaire to know what other activities the business would undertake if it had more resources (a ‘winning lotto’ scenario). The responses were varied.

Figure 11.02 shows that primary industry businesses placed the highest priority on buying machinery, equipment, or improving premises, and a low priority on increasing their marketing.
In contrast with businesses in the primary industry, those in the service industries prioritised increasing the marketing of their business, and put a much lower priority on buying machinery, equipment, or improving their premises (see figure 11.03).

Like the primary industries, manufacturing businesses had the same high priority for buying machinery, equipment, or improving premises, and for undertaking R&D.
Figure 11.04

What manufacturing industry businesses(1) want to spend more time and money on 2012

Manufacturing businesses said what they most wanted to spend more time and money on was capital improvements. This was followed by undertaking R&D, and increasing marketing.

2. The percentages reported in this category will almost certainly over-represent the proportion of all businesses.

Source: Statistics New Zealand
In this chapter we compare R&D activity in New Zealand with R&D activity in other countries. Our comparison is based on R&D expenditure as a proportion of a country’s GDP. We also compare New Zealand and Australia R&D expenditure by industry as Australia is one of our closest trading partners.

How New Zealand compares with OECD countries

Compared with other OECD countries of similar size, New Zealand’s R&D expenditure is low (see figure 12.01).

Figure 12.01

Research and development expenditure as a proportion of GDP in OECD countries

By sector
Latest available year

Country

Business
Government
Higher education

0
1
2
3
4
5

Percent

New Zealand¹

OECD total

Australia

Singapore

United Kingdom

Ireland

Italy¹

Hungary

Turkey

Poland

Argentina

Mexico

Israel

Finland

Denmark

United States

Source: Statistics New Zealand

1. Data for countries other than New Zealand and Italy only available for 2010.

While New Zealand’s proportion of R&D undertaken by the government sector has traditionally been higher than that of other countries, the proportion undertaken by businesses has been low. Government R&D is driven by Crown research institutes, which are some of the larger R&D performers in New Zealand. These organisations conduct industry-good research, which in other countries would be covered by the business sector.
From 2010 to 2012, business R&D increased at a faster rate than higher education R&D. Combined with the slight decrease in government R&D, this has brought New Zealand closer to the proportions seen in other countries.

Table 12.01 shows selected OECD countries’ gross expenditure on R&D as a proportion of GDP for the period 2006–12.

### Table 12.01

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2.01</td>
<td>2.26</td>
<td>2.20</td>
<td>..</td>
</tr>
<tr>
<td>Denmark</td>
<td>2.48</td>
<td>2.85</td>
<td>3.07</td>
<td>..</td>
</tr>
<tr>
<td>Finland</td>
<td>3.48</td>
<td>3.70</td>
<td>3.90</td>
<td>..</td>
</tr>
<tr>
<td>Ireland</td>
<td>1.25</td>
<td>1.46</td>
<td>1.71</td>
<td>..</td>
</tr>
<tr>
<td>Israel</td>
<td>4.51</td>
<td>4.77</td>
<td>4.34</td>
<td>..</td>
</tr>
<tr>
<td>Singapore</td>
<td>2.18</td>
<td>2.65</td>
<td>2.09</td>
<td>..</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1.74</td>
<td>1.76</td>
<td>1.80</td>
<td>..</td>
</tr>
<tr>
<td>United States</td>
<td>2.65</td>
<td>2.88</td>
<td>2.83</td>
<td>..</td>
</tr>
<tr>
<td>OECD total</td>
<td>2.24</td>
<td>2.34</td>
<td>2.38</td>
<td>..</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1.14</td>
<td>1.10</td>
<td>1.26</td>
<td>R</td>
</tr>
</tbody>
</table>

1. Data for 2006 onwards is from Organisation for Economic Co-operation and Development (OECD) *Main Science and Technology Indicators (MSTI): 2012/2*.

Symbols:
- .. nct available
- R revised
- P provisional

Source: Statistics New Zealand

Within each country, R&D activity is focused on different industries. New Zealand and Australia both use the Australian and New Zealand Standard Industrial Classification (ANZSIC), which allows an industry comparison between the two countries. In dollar terms, Australia’s R&D expenditure is far higher than New Zealand’s, but as a proportion of GDP it is still lower than the OECD average.

Primary industry R&D (the primary industries include the mining industry) makes up a higher proportion of business R&D expenditure in Australia than in New Zealand. However, the manufacturing industry makes up a higher proportion of business R&D expenditure in New Zealand than in Australia. For New Zealand, the machinery and equipment manufacturing industry contributes the most toward R&D expenditure in the manufacturing industry. This industry covers a wide range of manufacturing activity including transport, scientific, computer, and agricultural equipment.

Figure 12.02 compares the industry proportions of R&D expenditure for New Zealand and Australia in 2012.
Figure 12.02

Percentage of business research and development by industry
New Zealand and Australia

Industry

Services

Manufacturing

Primary

Source: Statistics New Zealand
This chapter provides technical information about the R&D Survey.

Period-specific information
This section contains information that has changed since the last survey.

Reference period
The reference period for the latest survey was the 2011/12 financial year. Businesses with balance dates falling between 1 January and 30 September supplied data for the year ending 2012. Businesses with balance dates falling between 1 October and 31 December supplied financial data for the year ending 2011.

Target population
The target population is all economically significant enterprises that have been pre-identified as performing or funding R&D activities in New Zealand. See the following section, ‘Changes to the Research and Development Survey 2012’.

Changes to the Research and Development Survey 2012

Changes in the target population
The R&D Survey: 2012 featured a change in the target population from ‘all economically significant enterprises that perform or fund R&D in New Zealand’ to ‘all economically significant enterprises that have been pre-identified as performing or funding R&D activities in New Zealand’.

There are a range of information sources available that allow us to identify R&D performers. These, combined with the last few iterations of this survey, have allowed us to build a consistent picture of the types of firms carrying out R&D in New Zealand. The changes made to the 2012 survey allow us to more intensively survey these businesses and create a better picture of individual R&D performers and their characteristics.

There were two main changes in identifying the population. The first was removing from the population any business that could not be pre-identified as being likely to perform R&D. This was partly offset by adding all businesses that applied for a grant from the Ministry of Science and Innovation in the three years before, rather than just those who received a grant over that time.

Break in the time series
The changes have caused a break in the time series, so 2012 results should not be compared directly with previous results. However, adjusted 2010 results have been modelled on the 2012 population criteria, to compare with the 2012 results. Care should be taken in interpreting the adjusted 2010 results.

Changes in the questionnaire
New categorical questions were added to the R&D Survey sent to businesses. These questions asked about opportunities for expansion, the main reason the business carried out R&D, how long it takes a business to break even on its R&D investment, and what it expects to happen to its level of R&D over the next year.

Summary of changes to the survey population
The sample for the R&D Survey: 2012 consisted of 3,444 enterprises, plus the eight universities and their commercial arms.
The target overall response rate for the R&D Survey: 2012 was 85 percent for business, government, and Crown research institutes (CRI). The target overall response rate for the higher education (universities) survey was 100 percent, which was achieved. The survey achieved a response rate of 88 percent.

Some businesses were identified as key units if their response to a survey question was considerable in the previous survey period. The target response rate was 100 percent for businesses identified as key units. However, due to one unit qualifying for compassionate exclusion, 99 percent was achieved.

The sampling error on the total R&D expenditure figure has been measured at 1.5 percent at the 95 percent confidence level.

There is no sampling error for the university sector due to the full coverage of this sector. The sampling error on the R&D expenditure figures at the 95 percent confidence level for the total business sector is 3.3 percent; for the total government sector it is 0.4 percent.

The table below provides a numerical summary of the changes in the R&D survey population, as well as associated changes in the sample, number of responders, and sampling errors.

Table 13.01
Summary of changes to the research and development survey population

<table>
<thead>
<tr>
<th>Type of change</th>
<th>2010</th>
<th>2010 adjusted</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>63,123</td>
<td>3,834</td>
<td>4,176</td>
</tr>
<tr>
<td>Government</td>
<td>302</td>
<td>123</td>
<td>111</td>
</tr>
<tr>
<td>Higher education</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>63,435</td>
<td>3,963</td>
<td>4,296</td>
</tr>
<tr>
<td>Sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>3,396</td>
<td>1,602</td>
<td>3,333</td>
</tr>
<tr>
<td>Government</td>
<td>300</td>
<td>120</td>
<td>111</td>
</tr>
<tr>
<td>Higher education</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>3705</td>
<td>1,728</td>
<td>3,447</td>
</tr>
<tr>
<td>Number of responders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>2,868</td>
<td>1,371</td>
<td>2,922</td>
</tr>
<tr>
<td>Government</td>
<td>282</td>
<td>117</td>
<td>99</td>
</tr>
<tr>
<td>Higher education</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>3,159</td>
<td>1,494</td>
<td>3,030</td>
</tr>
<tr>
<td>Response rate(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>84</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>Government</td>
<td>94</td>
<td>96</td>
<td>89</td>
</tr>
<tr>
<td>Higher education</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>Yes to R&amp;D(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>816</td>
<td>744</td>
<td>1,491</td>
</tr>
<tr>
<td>Government</td>
<td>78</td>
<td>57</td>
<td>63</td>
</tr>
</tbody>
</table>

Table continued next page
Table 13.01 continued
Summary of changes to the research and development survey population

<table>
<thead>
<tr>
<th>Type of change</th>
<th>2010</th>
<th>2010 adjusted</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher education</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>903</td>
<td>808</td>
<td>1,560</td>
</tr>
</tbody>
</table>

R&D performers as a percentage of responders

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2010 adjusted</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>28</td>
<td>54</td>
<td>51</td>
</tr>
<tr>
<td>Government</td>
<td>28</td>
<td>49</td>
<td>64</td>
</tr>
<tr>
<td>Higher education</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>54</td>
<td>51</td>
</tr>
</tbody>
</table>

Sample errors

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2010 adjusted</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>5.6</td>
<td>5.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Government</td>
<td>0.4</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Higher education</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>2.3</td>
<td>2.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

1. Response rate = number of responders divided by sample.
2. ‘Yes to R&D’ means that a business is carrying out and/or funding R&D.
3. R&D performers as a percentage of responders = ‘yes to R&D’ divided by number of responders.

Note: Some figures may not add to stated totals due to rounding.
Source: Statistics New Zealand

The population has reduced significantly from 2010 to 2012, due to the change in target population. Only businesses that were pre-identified as carrying out R&D were included. The sample size and response rate have remained relatively stable from 2010 to 2012, but the number of responders answering ‘yes’ to R&D increased significantly, from 816 in 2010, to 1,491 in 2012. This is expected, as the businesses pre-identified as carrying out R&D are being surveyed more intensively.

Sampling errors have reduced significantly from 2010 adjusted to 2012 for the business sector and overall R&D. The main cause of this is that a much higher proportion of the business sector population was sampled in 2012.

Response rates by industry
Table 13.02 shows response rates by industry within the business sector.

Table 13.02
Response rates by industry – business sector

<table>
<thead>
<tr>
<th>Published industry</th>
<th>Response rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>84</td>
</tr>
<tr>
<td>Food product manufacturing</td>
<td>92</td>
</tr>
<tr>
<td>Beverage and tobacco manufacturing</td>
<td>83</td>
</tr>
<tr>
<td>Textiles, clothing, footwear, and leather manufacturing</td>
<td>90</td>
</tr>
<tr>
<td>Petroleum, coal, chemical, and associated product manufacturing</td>
<td>88</td>
</tr>
</tbody>
</table>

Table continued next page
Response rates by industry – business sector

<table>
<thead>
<tr>
<th>Published industry</th>
<th>Response rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-metallic mineral product manufacturing</td>
<td>87</td>
</tr>
<tr>
<td>Metal product manufacturing</td>
<td>92</td>
</tr>
<tr>
<td>Machinery and equipment manufacturing</td>
<td>91</td>
</tr>
<tr>
<td>Other manufacturing</td>
<td>87</td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>87</td>
</tr>
<tr>
<td>Scientific research and technical services</td>
<td>90</td>
</tr>
<tr>
<td>Computer services</td>
<td>86</td>
</tr>
<tr>
<td>Other services</td>
<td>87</td>
</tr>
<tr>
<td>Services</td>
<td>87</td>
</tr>
<tr>
<td>Total business sector</td>
<td>88</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand

Sampling error by industry

Table 13.03 shows the business sector sampling error on R&D expenditure by published industry. These sample errors need to be taken into account when using data at published industry level.

Table 13.03
Sample error by industry – business sector, 2012

<table>
<thead>
<tr>
<th>Published industry</th>
<th>Sample error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>5.5</td>
</tr>
<tr>
<td>Food product manufacturing</td>
<td>8.0</td>
</tr>
<tr>
<td>Beverage and tobacco manufacturing</td>
<td>17.6</td>
</tr>
<tr>
<td>Textiles, clothing, footwear, and leather manufacturing</td>
<td>13.0</td>
</tr>
<tr>
<td>Petroleum, coal, chemical, and associated product manufacturing</td>
<td>6.3</td>
</tr>
<tr>
<td>Non-metallic mineral product manufacturing</td>
<td>11.9</td>
</tr>
<tr>
<td>Metal product manufacturing</td>
<td>5.5</td>
</tr>
<tr>
<td>Machinery and equipment manufacturing</td>
<td>8.9</td>
</tr>
<tr>
<td>Other manufacturing</td>
<td>15.6</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>5.3</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>6.4</td>
</tr>
<tr>
<td>Scientific research and technical services</td>
<td>6.4</td>
</tr>
<tr>
<td>Computer services</td>
<td>9.3</td>
</tr>
<tr>
<td>Other services</td>
<td>9.0</td>
</tr>
<tr>
<td>Services</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand
Current and capital expenditure

The survey sample was designed to minimise sample error at sector level. At published industry level, sample errors are higher, due to the smaller numbers in each of these groups.

Wages and salaries in the business and government sectors include wages and salaries for R&D personnel. They also include other employment-related costs (e.g., overtime, holiday pay, sick pay, redundancy, and severance payments). They exclude wages and salaries of personnel indirectly supporting R&D. Wages and salaries in the higher education sector are modelled estimates based on total university wages, salaries, and other employment-related costs.

Other current expenditure in the business and government sectors include all consumables and overheads incurred by direct and indirect R&D support activities (e.g., materials, power, rent, repairs). It includes the wages and salaries of personnel indirectly supporting R&D (only the part of wages and salaries that is attributable to the indirect support of R&D), for example, central finance or personnel services. Other current expenditure in the higher education sector is a modelled estimate, based on all consumables and overheads incurred by direct and indirect university support activities.

Depreciation is excluded in all three sectors.

Capital expenditure on R&D in the business and government sectors include purchases of land and buildings, and purchases of plant, equipment, machinery, vehicles, capitalised software, and other assets. Capital expenditure in the higher education sector is a modelled estimate, based on total university land and buildings; and purchases of plant, equipment, machinery, vehicles, capitalised software, and other assets.

Bioscience expenditure on research and development

Bioscience is the development and application of knowledge of the way plants, animals, and humans function for the development of products and services. Bioscience has applications in diverse fields such as health, animal and plant breeding, food manufacturing, and aquaculture.

Respondents to the survey are asked whether any of their expenditure on internal R&D is attributable to bioscience.

This total ($495 million) in 2012, cannot be compared with expenditure from Statistics NZ’s Bioscience Survey, for the following reasons:

- The R&D Survey only includes bioscience that forms part of a business’s R&D. The Bioscience Survey includes non-R&D expenditure.
- The R&D Survey collects information from pre-identified R&D performers. The Bioscience Survey collects expenditure information from businesses whose main activity is bioscience. While some businesses will respond to both surveys, there are many in one but not the other.
General information
This section contains information that does not change between surveys.

Survey background
R&D Survey: 2012 was jointly developed by Statistics NZ with the Ministry of Science and Innovation (MSI). From 1 July 2012, MSI has become part of the Ministry of Business, Innovation and Employment.

The R&D Survey measures the level of R&D activity, employment, and expenditure by businesses, government departments, government-owned trading entities, and higher education (universities). The R&D Survey is conducted every two years by Statistics NZ. Results from surveys before 2002 were released by the Ministry of Research, Science, and Technology, which was amalgamated with the Foundation of Research, Science, and Technology in February 2011 to create MSI.

Data collection
The R&D Survey is a postal survey consisting of four questionnaires: a business questionnaire, a government questionnaire, a CRI questionnaire, and a higher education (universities) questionnaire. These questionnaires are specifically designed to capture data on R&D from these different organisation types.

The business, government, and CRI questionnaires were posted out in mid-August 2012. Information collected included:

- the number of personnel within an enterprise working on R&D
- current and capital expenditure on R&D
- expenditure by type of R&D
- source of funds for R&D carried out
- the area of application of the R&D.

Information was requested for the last financial year within the 12 months ending 30 September 2012.

The higher education (universities) questionnaire was also sent in August 2012. Data was collected for the year ended 31 December 2011. The higher education (universities) questionnaire was designed to allow universities to use financial information that is generally produced for annual reporting purposes. This means that a number of data items for universities' R&D were produced using modelled information. Universities New Zealand – Te Pōkai Tara assisted Statistics NZ in determining these modelling specifications. Information collected included university discretionary income, internal and external research funding, academic staff salaries, university operating expenditure by faculty, and R&D personnel data.

Survey population
Enterprises (business, government, and CRI) are included in the R&D Survey population if they:

- are economically significant and active on the Statistics NZ Business Frame
- are not classified to ANZSIC06 codes 'G', 'H', 'I', or 'P'
- are a university
- fulfil one or more of the following indicators of R&D activity:
  - enterprises indicating they undertook R&D in the Annual Frame Update Survey
enterprises applying for funding from the Ministry of Science and Innovation (and its predecessor agencies) in 2010, 2011, or 2012

○ enterprises applying for patents in the last two years

○ enterprises recording R&D activity in the 2011 Business Operations Survey or the previous two R&D Surveys (only from full coverage strata)

○ enterprises recording R&D activity in the 2011 Bioscience Survey.

The exclusion of ANZSIC division codes ‘H’ (accommodation and food services), ‘G’ (retail trade), and ‘I’ (transport, postal and warehousing) is due to the previous equivalents of these industries showing little or no contribution to the total reported expenditure on R&D in the 2002 survey. Such contributions were considered too small to justify their inclusion in the survey population so the equivalent industries have been excluded since the 2004 R&D Survey. ANZSIC division ‘P’ (education and training) has been excluded, with the exception of universities that perform most of the R&D in this industry.

Sample design

The R&D Survey uses a stratified sample in its sample design. Strata were developed based on industries defined by their sector (ie business, government, or higher education (universities)) and ANZSIC06.

Substrata were then developed using RME and annual GST from the Statistics NZ Business Frame. These are both captured from tax data.

Some of these substrata were made full coverage, meaning that all enterprises in the substratum were selected for the survey. Within the full coverage substrata, keys were identified for intensive attention in the data collection phase. Keys are enterprises that made significant R&D expenditure in 2010.

Measurement errors

The R&D Survey results are subject to measurement errors. These need to be considered when analysing the results from the survey.

Measurement errors include mistakes by respondents when completing the questionnaire, variation in respondents’ interpretation of the questions asked, and errors made during the processing of the data. In addition, the survey applies imputation methodologies to cope with non-respondents and item non-response (see Imputation methodology for more detail). These methods are not without error.

Statistics NZ adopts procedures to minimise these types of errors, but they may still occur and are not quantifiable.

Given the nature of the data collected, there are limitations on the level of accuracy that can be expected from the R&D Survey. Many respondents do not keep a separate account of their R&D expenditure, or they may include R&D with other scientific and technological services, such as consulting.

Analysis of results

The R&D Survey results have been compared with annual reports and other indicators published by Statistics NZ. Where the survey results differed substantially, more detailed study of the data was made.

Imputation methodology

This section gives an outline of the imputation methodology used in the 2012 survey (business, government, and CRIs). No unit non-response was required for the R&D higher education (universities) survey, as a 100 percent response rate was achieved.
Unit non-response
Unit (or complete) non-response occurs where units in the population do not return the questionnaire, or an invalid questionnaire is received. A weight adjustment method is used to rate up the responding firms to compensate for the non-responding firms within the same estimation cell. The data from responding firms are multiplied by the inverse of the response rate for the estimation cell.

Any enterprises that cease operation during the survey period are removed from the weight calculations.

Item non-response
Item (or partial) non-response is where units return the questionnaire but fail to provide data for selected aggregates.

Item non-response imputation was applied to breakdowns where a total could be sourced from another question and personnel questions where data was not provided. The item non-response imputation method then used the mean proportion of all responding linked units (excluding outliers) within the item non-response estimation cell, and applied these proportions to the sourced total. For personnel questions the totals were imputed using a similar method.

Published sector and industry breakdowns
The published sector and industry breakdowns provided in this report were created using recommendations from the *Frascati manual 2002* (OECD, 2002) to allow for greater international comparability.

This manual recommends that state-owned enterprises (business type 1996 classification) be classified to the business sector. In addition, the manual recommends that the industrial classification code for significant research organisations be changed to the industry they predominantly serve. The industry breakdowns have been applied using the Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC06).

Business sector
Includes central and local government-owned trading enterprises and all other enterprises with New Zealand Institutional Sector 1996 codes as listed in table 13.04.

Table 13.04
Business sector institutional codes

<table>
<thead>
<tr>
<th>NZSIC96 code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1331(1)</td>
<td>Central government enterprises</td>
</tr>
<tr>
<td>1321(1)</td>
<td>Local government enterprises</td>
</tr>
<tr>
<td>1111</td>
<td>Private corporate producer enterprises</td>
</tr>
<tr>
<td>1121</td>
<td>Private non-corporate producer enterprises</td>
</tr>
<tr>
<td>1211</td>
<td>Producer boards</td>
</tr>
<tr>
<td>2211</td>
<td>Private registered banks</td>
</tr>
<tr>
<td>2221</td>
<td>Private other broad money (M3) depository organisations</td>
</tr>
<tr>
<td>2291</td>
<td>Private other depository organisations</td>
</tr>
<tr>
<td>2311</td>
<td>Private other financial organisations except insurance and pension funds</td>
</tr>
<tr>
<td>2411</td>
<td>Private insurance and pension funds</td>
</tr>
<tr>
<td>4</td>
<td>Private non-profit organisations serving households</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand
Government sector (excluding universities)

The government sector excludes the eight universities, and central and local government trading enterprises, and includes all enterprises with the New Zealand Institutional Sector Classification 1996 (NZISC96) codes included in the table below.

Table 13.05

**Government sector institutional codes**

<table>
<thead>
<tr>
<th>NZSIC96 code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1331(1)</td>
<td>Central government enterprises</td>
</tr>
<tr>
<td>1321(1)</td>
<td>Local government enterprises</td>
</tr>
<tr>
<td>2111</td>
<td>Central bank</td>
</tr>
<tr>
<td>2212</td>
<td>Central government registered banks</td>
</tr>
<tr>
<td>2213</td>
<td>Local government registered banks</td>
</tr>
<tr>
<td>2222</td>
<td>Central government other broad money (M3) depository organisations</td>
</tr>
<tr>
<td>2223</td>
<td>Local government other broad money (M3) depository organisations</td>
</tr>
<tr>
<td>2292</td>
<td>Central government other depository organisations nec</td>
</tr>
<tr>
<td>2293</td>
<td>Local government other depository organisations nec</td>
</tr>
<tr>
<td>2312</td>
<td>Central government other financial organisations except insurance and pension funds</td>
</tr>
<tr>
<td>2313</td>
<td>Local government other financial organisations except insurance and pension funds</td>
</tr>
<tr>
<td>2412</td>
<td>Central government insurance and pension funds</td>
</tr>
<tr>
<td>2413</td>
<td>Local government insurance and pension funds</td>
</tr>
<tr>
<td>3</td>
<td>General government (excluding universities)</td>
</tr>
</tbody>
</table>

1. Central and local government trading enterprises are included in business sector.

Source: Statistics New Zealand

Higher education (universities)

The higher education (universities) sector includes the eight New Zealand universities that are members of Universities New Zealand – Te Pōkai Tara. These are classified to NZISC96 code 3111 (central government excluding funded social security), with an ANZSIC06 code of P810200 (higher education).

Included within the higher education sector are universities’ commercial arms. Prior to 2010, they were represented in the business sector.

Feasibility studies conducted by Statistics NZ and MBIE have found there is an insignificant amount of R&D being carried out in other higher education institutions (for example, polytechnic institutes). Therefore, they have been excluded from the survey.

Published industries

The published industries within the business sector are based on ANZSIC06, apart from the reclassification of significant scientific research organisations (M691) to the industry they predominately serve and the inclusion of local and state-owned trading enterprises. The published industries are listed below, followed by their ANZSIC06 codes.
Business sector
Primary industries – A and B
Food product manufacturing – C11
Beverage and tobacco manufacturing – C12
Textile, clothing, footwear, and leather manufacturing – C13
Petroleum, coal, chemical, and associated product manufacturing – C17, C18, and C19
Non-metallic mineral product manufacturing – C20
Metal product manufacturing – C21 and C22
Machinery and equipment manufacturing – C23 and C24
Other manufacturing – C14, C15, C16, and C25
Wholesale trade – F
Scientific research and technical services – M691 and M692 (excluding M6924)
Computer services – M70
Other services – D to S excluding (F, M691, M6921, M6922, M6923, M6925, M70)

Government sector
Scientific research – M691
Other government research – All ANZSIC codes except M691

Higher education (universities) sector
Total universities, including their commercial arms.

Confidentiality and rounding
Data published from the R&D Survey: 2012 is governed by the provisions of the Statistics Act 1975, which requires that all statistical information published by Statistics NZ must be arranged so that no individual respondent can be identified. Cell suppression was used to prevent the disclosure of sensitive information.

Privacy, security, and confidentiality of information supplied to Statistics NZ has more on Statistics NZ confidentiality rules.

On occasion, figures are rounded to the nearest thousand or some other convenient unit. This may result in a total disagreeing slightly with the total of the individual items shown in tables. Where figures are rounded, the unit is generally expressed in words below the table headings, but where space does not allow this the unit may be shown as, for example, (000) for thousands.

All counts of businesses in this report were randomly rounded to base 3 to protect the confidentiality of respondents. Totals are rounded independently of the components, so not all components will add to the stated totals. All counts of personnel were rounded using a graduated random rounding approach. Again, not all components will add to the stated totals.


Appendix 1 – Questionnaires

The R&D Survey is a postal survey consisting of four questionnaires. These questionnaires are specifically designed to capture data on R&D from these different organisation types.

To view the questionnaires for each sector, click on the appropriate links below. They are available on the Statistics NZ website www.stats.govt.nz.

- Business sector
- Government sector
- Crown research institutes

The questionnaire for the higher education (universities) sector is in Excel format, which respondents find easier to use.