

The New Zealand Biotechnology Industry
Capability Survey

Report to New Zealand Trade and Enterprise

July 2003

BIOTENZ

New Zealand
TRADE & ENTERPRISE 

Preface

This report has been prepared for BIOTENZ by Robin Cooper from Tradex NZ Ltd. The assistance of Dr Jenny Neale from Victoria University with questionnaire design and layout is gratefully acknowledged. Dan Marsh from Waikato University also provided useful advice on questionnaire content.

We are indebted to the many industry members who contributed expertise and experience, through participation in discussions or by providing responses to the survey. The rate of return for this survey has been very high, largely due to the generosity of industry members and the efforts of Penelope Austin, Executive Director of BIOTENZ, who co-ordinated follow-up activities.

Helpful advice and feedback was received from the BIOTENZ Capability Survey committee – Jim McLean (Genesis Research and Development), Sue Barrett (Industrial Research) and Damian Camp (Ovita).

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1 Foreword

BIOTENZ is to be commended for producing this detailed snapshot of the biotechnology sector in New Zealand. With an overall 78% response rate (93% in the core biotechnology sector) it gives a unique industry perspective into the status, opportunities and challenges of our biotechnology community. The way the statistics are presented, coupled with the wide and sometimes contradictory range of statements from individuals who are passionate about the industry, make the report a fascinating read. Some of the main points from the survey include:

- Biotechnology in New Zealand is a growing industry with almost 50% of the 42 core biotechnology companies being created in the last three years.
- Core biotechnology companies expect to bring 750 products to market in the next five years.
- There are many collaborations and joint projects within the industry, both with New Zealand and overseas organisations. Just as important, there is a willingness to develop even more partnerships.
- At least 244 patents have been granted to core biotechnology companies during the last five years.
- Many respondents to the survey are concerned about lack of funding but are aware that this is a global challenge.
- There is a need for expertise and funding to commercialise ideas.
- Public education is viewed as being very important, as is international recognition of New Zealand competencies in biotechnology.
- Core biotechnology companies predict they will need to double the number of employees with tertiary qualifications within the next five years.

I believe the information and trends highlighted by this survey will be invaluable in shaping future projects aimed at building the critical mass of the biotechnology community as recommended in the Biotechnology Taskforce report published in May 2003. Also, I trust this will be the first in a series of reports produced by industry to monitor the status of biotechnology in New Zealand.

Peter Lennox



Director Biotechnology

New Zealand Trade and Enterprise

2 Background to the Survey

2.1 Introduction

The biotechnology industry in New Zealand is constantly changing and developing, and the data compiled in this report provide a "snapshot" of the industry as it was in the first few months of 2003. Over the nine months between an initial BIOTENZ scoping survey and compilation of this report there have been more than 100 changes to the BIOTENZ database, through organisations entering and leaving the industry, or through restructuring, mergers and acquisitions.

Responses have been received from 78% of organisations surveyed, and data from these responses are presented in this report. No attempt has been made to extrapolate and draw conclusions about the entire industry from the data received. Some quite large organisations have not responded, and the potential of their data on the overall industry data is unknown. The definition of biotechnology can be found under Section 11.

BIOTENZ is a group of leading New Zealand providers of biotechnology, natural products, pharmaceutical and biological products and services.

In 2002, a scoping survey of the New Zealand biotechnology industry was commissioned by BIOTENZ, and a database compiled to give a broad picture of the industry. From there and under direction of the newly formed Biotechnology Taskforce, it was agreed that Industry New Zealand and BIOTENZ would conduct a more detailed Capability Survey of the biotechnology industry.

On July 1, 2003 Industry New Zealand merged with Trade New Zealand to form New Zealand Trade and Enterprise, the Government's trade and economic development agency.

The aims of the Capability Survey were:

- 1 To identify the drivers of economic performance in the biotechnology industry in New Zealand and record measures of intellectual property development, research activity, investment, employment, and strategic alliances.
- 2 To identify industry capabilities and strengths, and make information available to organisations in a way that encourages networking and facilitates marketing of the New Zealand biotechnology industry.
- 3 To develop a format that can be replicated so that the industry can be re-measured over time in order to assess the impact of Government policies and industry initiatives on economic growth.

Findings are documented in the report under the industry subgroups (Research Organisations, Core Biotechnology, Other Biotechnology, Natural Products, Suppliers to the Industry) and an industry-wide overview is provided in Section 10.

The BIOTENZ database compiled during the scoping survey was checked and refined. Questionnaires were developed, printed, and sent out to 350 organisations and university departments in the database. There was one questionnaire for organisations engaged in the biotechnology industry in New Zealand, and a separate questionnaire for Supplier organisations. The biotechnology questionnaire concentrated on collaborations and partnerships, management of Intellectual Property (IP) and the degree to which the organisations focus on research. The Supplier questionnaire presented a long list of products and services to capture the capabilities of the various Suppliers to the industry.

2.2 Organisations and categories

At the time the data collection phase of the Capability Survey was completed, 268 organisations were identified as being part of the New Zealand biotechnology industry. They have been categorised for data analysis as follows:

- 19 Research organisations.
- 42 Core Biotechnology organisations.
- 36 Other Biotechnology organisations.
- 43 Natural Products organisations.
- 128 Suppliers who provide goods and services to the industry.

See Table 1 for a description of the categories.

These 268 organisations can be considered part of the final survey, either as a respondent or non-respondent. Ten organisations that are subsidiaries of Other Biotechnology organisations or Suppliers were included in responses from their parent organisations, leaving 258 possible respondents. Research, Core Biotechnology, Other Biotechnology and Natural Products organisations responded to a biotechnology questionnaire, while Supplier organisations responded to a separate Supplier questionnaire. Copies of questionnaires are available on the BIOTENZ and New Zealand Trade and Enterprise websites and can be referred to for clarification.

Table 1: Categories used in the Capability Survey

CATEGORY	SUB-CATEGORY	QUESTIONNAIRE ANSWERED	DESCRIPTION
Research		Biotechnology	Carrying out pure research. Includes CRIs, universities, private research institutes.
Core Biotechnology		Biotechnology	Carrying out research, development and IP commercialisation in NZ.
Other Biotechnology		Biotechnology	Consists of product biotechnology, medical devices and pharmaceutical organisations.
	Product Biotechnology	Biotechnology	Producing biotechnology products and/or services in NZ, some product development but no primary research
	Medical Devices	Biotechnology	Developing medical device products in NZ. Most (but not all) of these organisations are also Core Biotechnology organisations.
	Pharmaceutical	Biotechnology	Developing, testing or manufacturing pharmaceutical products in NZ.
Natural Products		Biotechnology	Applying technology to the development and production of natural products in NZ.
Suppliers		Supplier	Providing goods and services to the biotechnology industry in NZ.

The Other Biotechnology category includes three sub-categories: Product Biotechnology, Medical Device and Pharmaceutical organisations. Numbers of organisations in these sub-categories are too small for confidentiality to be maintained if their data were to be presented separately.

Categories are somewhat different from those listed on the Biospherenz website. Once again, this has been necessary in order to maintain confidentiality of data.

Where there is overlap between categories, each organisation is categorised according to its main activities. For example, Core Biotechnology organisations that are developing medical devices remain in the Core Biotechnology group, not in Product Biotechnology along with Medical Device organisations.

2.3 Capability Survey data

Data from the survey are presented graphically by organisational category in Sections 3 to 7. Many of the respondents to the survey provided comments on the needs of the biotechnology industry, and these comments are summarised in Section 8 of this report. Summary data for the industry as a whole are listed in Section 10.

This report presents baseline data on the New Zealand biotechnology industry, against which future growth and development can be measured.

3 Capability Survey Results: Research Organisations

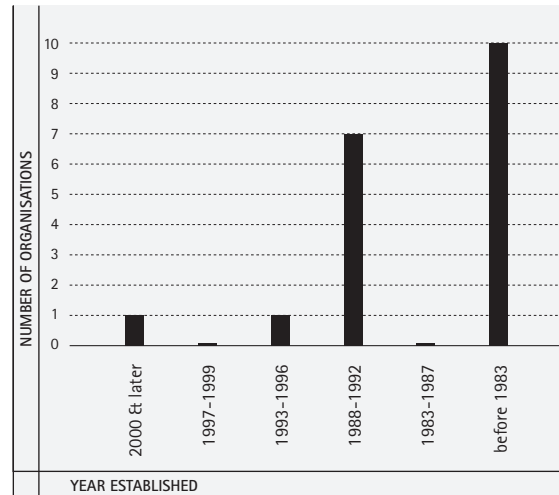
Research organisations include Crown Research Institutes (CRIs), universities, and private research institutions.

Collecting data from universities on biotechnology research and product development has proved difficult, as information systems within the universities are not geared to data collection by sector. In most cases, information was initially collected from individual departments, and consolidated to remove data duplications. However, as not all departments have responded, data from universities are less complete than for other respondent groups.

3.1 Organisational background and relationships

All Research organisations are New Zealand-owned.

Figure 1 Some Research organisations were established quite recently



3.1.1 Collaborations and joint projects

Seventeen Research organisations report a total of 341 separate collaborative projects with 392 organisations.

Figure 2 Most collaborations involve research and product/process development

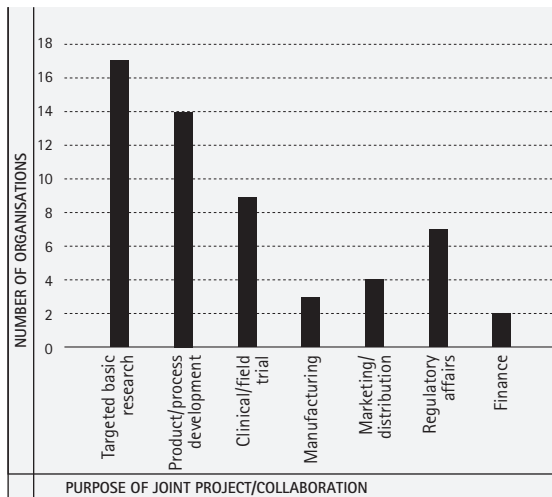
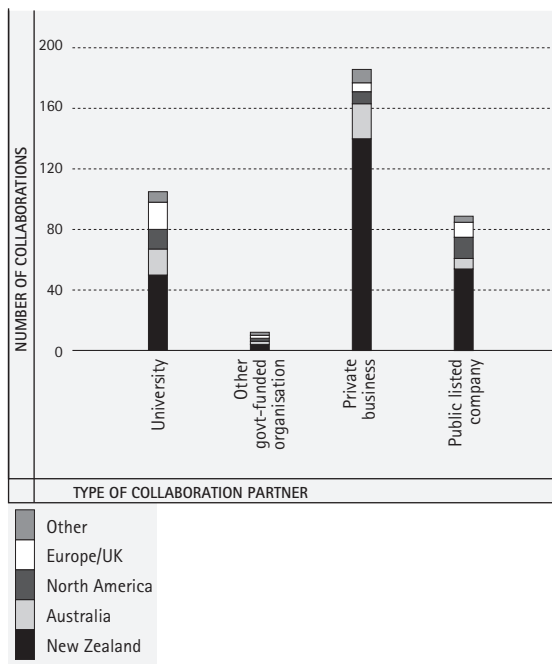


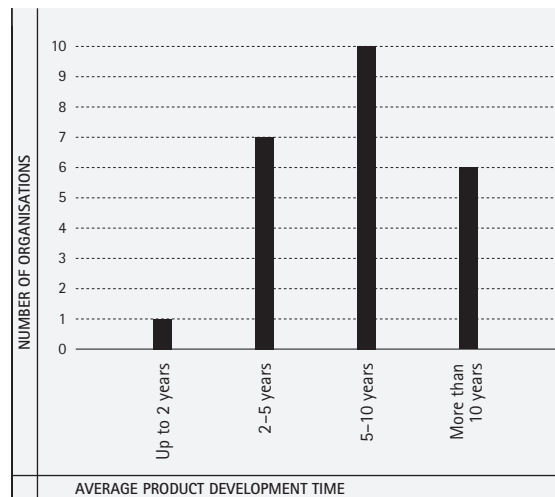
Figure 3 63% of collaborations are with NZ organisations, and 47% are with private business in NZ and overseas



Note: CRIs are included under other government-funded organisations

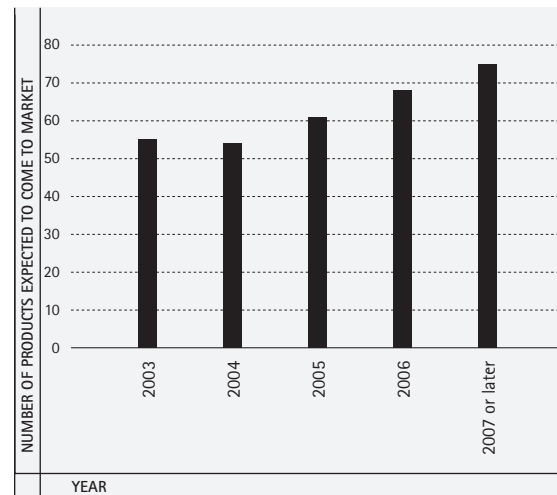
3.1.2 Products in development

Figure 4 Some products developed by Research organisations take 2-5 years to develop, but most take longer



Some organisations have a mix of product types, some with short development times and some taking longer to come to market.

Figure 5 Research organisation respondents report 313 products due to come to market over the next few years



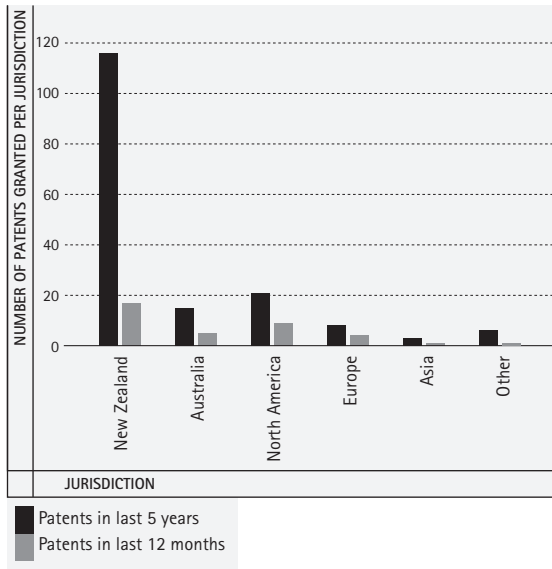
3 Capability Survey Results: Research Organisations

3.1.3 Research and Intellectual Property

3.1.3.1 Patents

Research respondents filed a total of 169 patents in the last five years.

Figure 6 Most patents are filed by Research organisations in NZ jurisdiction only

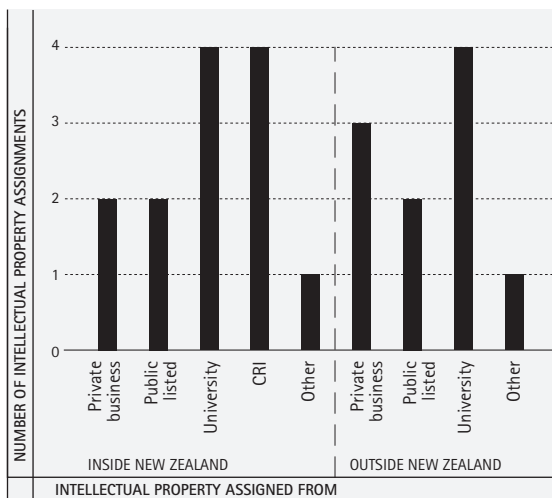


One hundred and fifty eight patents have been filed but not yet granted.

Research organisations spent \$1.78 million on patents and intellectual property management in the last financial year. Numbers of patents do not reflect number of inventions, as many organisations file more than one patent on an invention and also do so in more than one jurisdiction.

3.1.3.2 Contracted Intellectual Property

Figure 7 Ten Research organisations acquired the contractual right to use IP from other organisations in the last 12 months



Note that one CRI did not complete this section of the survey.

3.1.3.3 Papers in refereed journals

Research organisations report a total of 981 biotechnology-related papers published in refereed journals in the last 12 months.

3.2 Financial

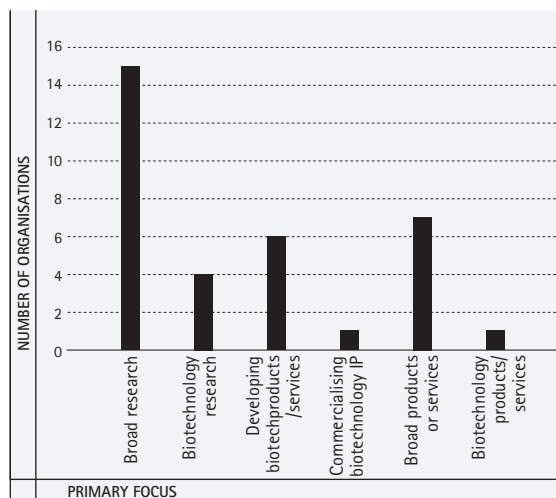
Some university departments have had some difficulty in deciding how to classify income and expense data, as universities generally do not account for income and expenditure by sector.

3.2.1 Focus

Organisations were asked to indicate their primary focus from up to two of the following categories:

- 1 Research organisation, broad focus including biotechnology.
- 2 Research organisation concentrating on biotechnology.
- 3 Research organisation developing specific biotechnology products or services.
- 4 Organisation commercialising biotechnology IP developed elsewhere.
- 5 Organisation producing and selling products or services, some biotechnology-related, some not.
- 6 Organisation producing and selling only biotechnology-related products or services.

Figure 8 Most Research organisations are engaged in research with a broad focus, not just on biotechnology



3.2.2 Income

Figure 9 There is a wide variation in the amount of biotechnology-related income reported by Research organisations

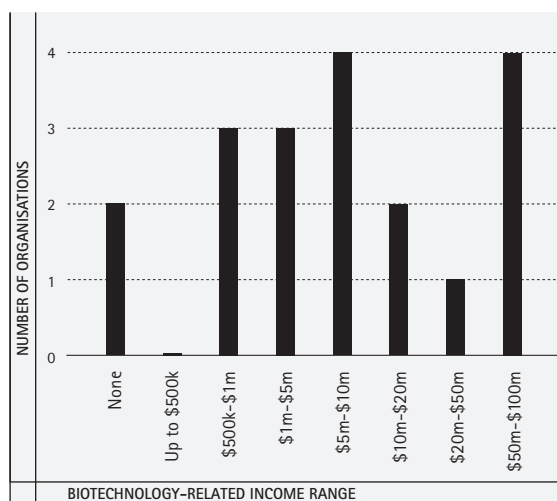
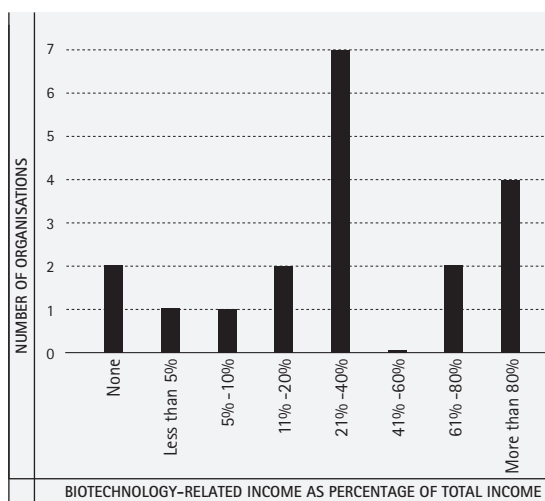


Figure 10 Thirteen Research organisations report that they obtain more than 20% of total income from biotechnology



3.2.2.1 Sources of biotechnology-related income

Table 2 Biotechnology-related government funding represents more than 80% of total income for four Research organisations

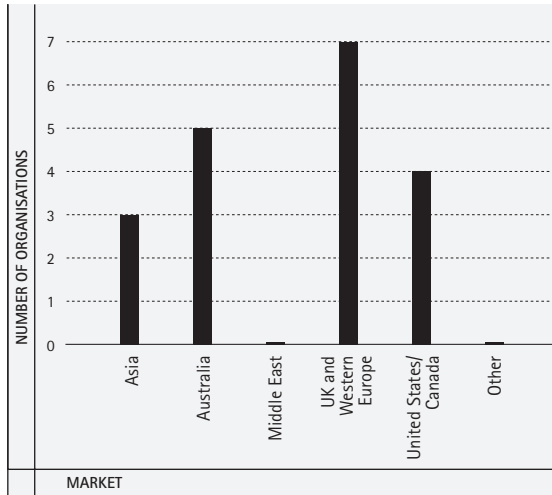
Source of biotechnology-related income	NUMBER OF RESEARCH ORGANISATIONS REPORTING BIOTECHNOLOGY-RELATED INCOME AS...						
	...less than 5% total income	...5%-10% total income	...11%-20% total income	...21%-40% total income	...41%-60% total income	...61%-80% total income	...more than 80% total income
Licensing	4	0	0	0	0	0	0
IP sales	4	0	0	0	0	0	0
Government	2	2	4	1	2	0	4
Product sales	3	2	0	1	0	0	0
Royalties	3	0	1	0	0	0	0
Services	2	5	0	2	0	0	1
Total	18	9	5	4	2	0	5

Licensing and sale of IP bring in less than 5% of total income for Research organisations. Income from biotechnology-related services represents more than 20% of total income for three Research organisations.

3.2.3 Export income

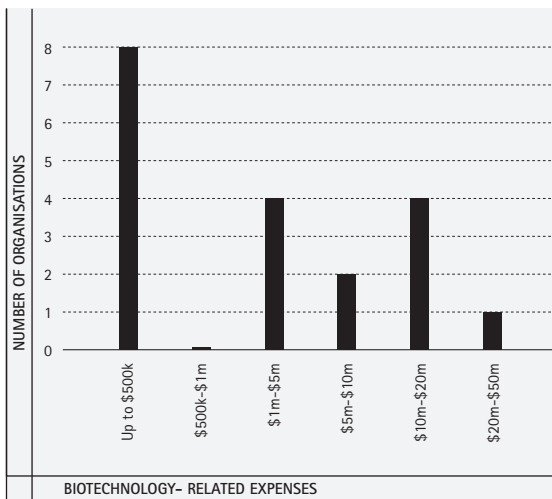
Seven Research organisations report a total of \$15.7 million in export income. Two respondents indicated a range rather than a number, and actual export income may lie between \$12.1 million and \$21.2 million.

Figure 11 Research organisations export to Australia, Europe, Asia and North America



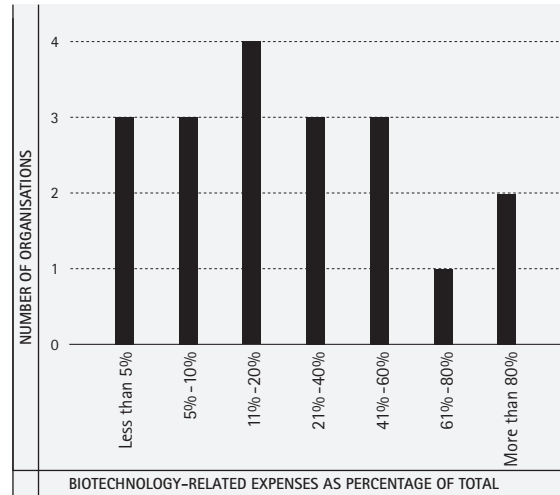
3.2.4 Biotechnology-related expenses

Figure 12 Eight out of 19 Research organisations report less than \$1 million per annum of biotechnology-related expenses



Biotechnology-related expenses include all costs directly related to biotechnology research or to biotechnology product/service development. For organisations working only in the biotechnology sector, 100% of expenses will be biotechnology-related.

Figure 13 For 10 Research organisations, biotechnology-related expenses represent less than 20% of total expenses



3.2.4.1 Regulatory costs and capital expenditure

In the last financial year, Research organisations report a total of

- \$4.8 million spent on regulatory approval processes.
- \$11.9 million spent on biotechnology-related equipment.
- \$13.0 million spent on specialised facilities related to biotechnology.

3.3 Staff

Research organisations report 1,974 full-time equivalent staff engaged in biotechnology-related activities. This appears to be around 14% of total staff employed by these organisations.

3.3.1 Qualifications

Research organisations report a total of 1,848 staff with tertiary qualifications engaged in biotechnology-related activities.

Table 3 Most staff are engaged in research activities

	DOCTORATE	MASTER'S DEGREE	BACHELOR'S DEGREE	DIPLOMA/CERTIFICATE	TOTAL
Research	770	326	470	60	1,626
Products and Services	49	19	38	20	126
Management	47	14	22	13	96

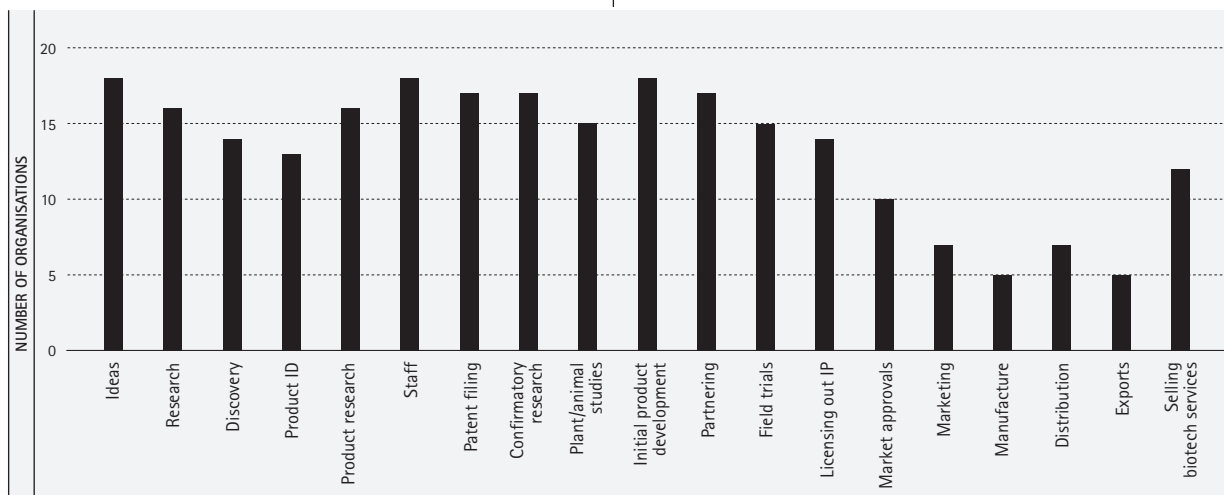
3.3.2 Future requirements for staff with tertiary qualifications

Table 4 Research organisations are predicting a 52% increase in requirement for tertiary qualified staff in biotechnology-related activities over the next five years

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	866	111	229	1,095
Master's degree	359	97	302	661
Bachelor's degree	530	218	345	875
Diploma/Certificate	93	77	90	183
Total	1,848	503	966	2,814

3.4 Capabilities

Figure 14 Few Research organisations report manufacturing and marketing capabilities



3.5 Products

3.5.1 Products on the market and under development

Research organisations report 214 products on the market, and 173 in development. (Product numbers appear to be significantly under-reported, given that there are 313 products expected to come to market in the next few years.)

Figure 15 90% of products listed by Research organisations are in horticulture, forestry and animal products

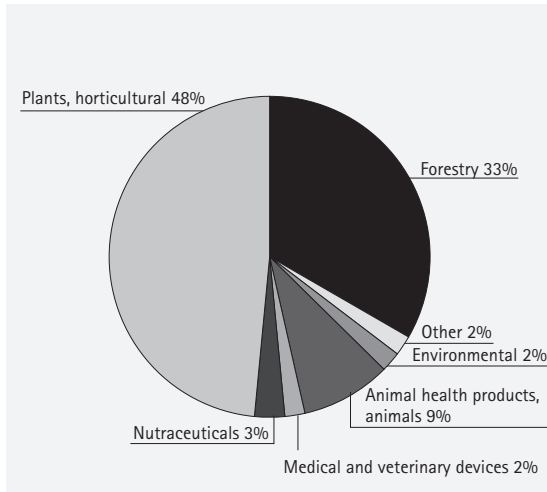
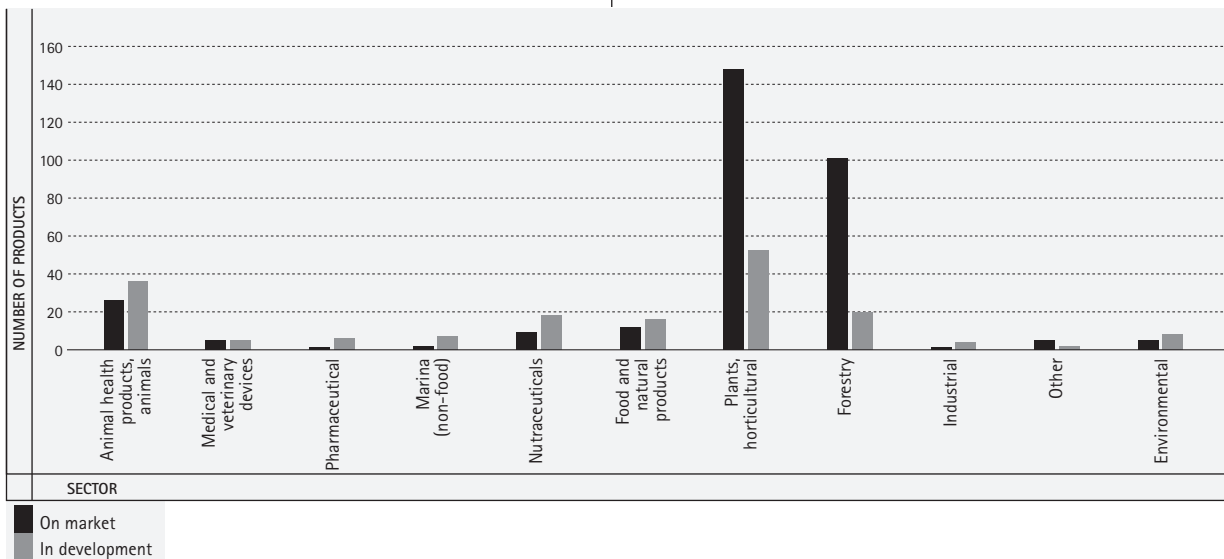


Figure 16 Some product development is reported in other sectors



3.5.2 Marketing channels

Figure 17 Most Research organisations focus on marketing directly to a specific industry

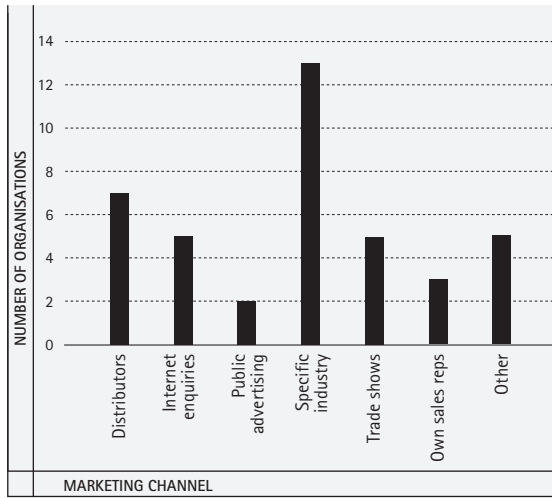
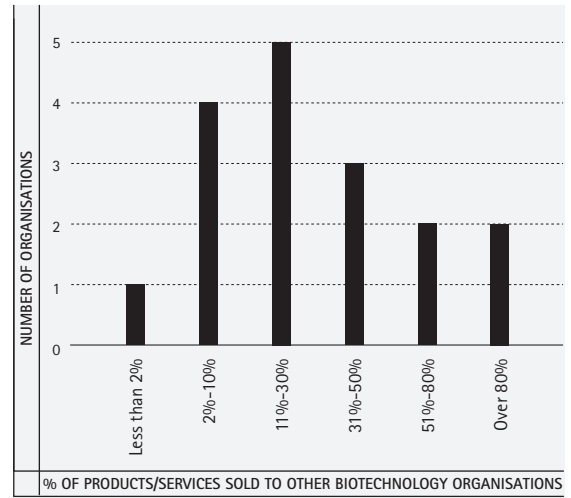


Figure 18 Ten of the 19 Research organisations report that less than 30% of their products and services are sold to biotechnology organisations

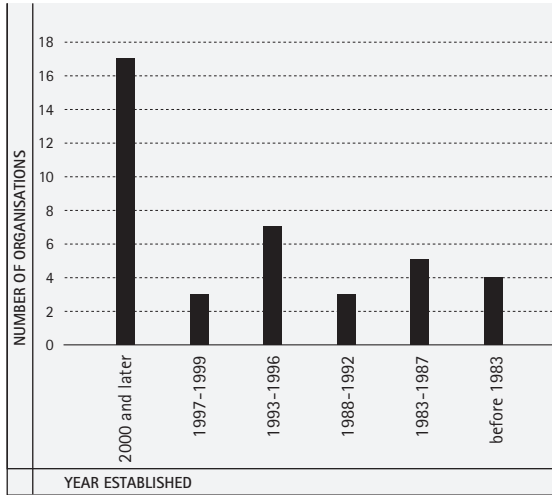


4 Capability Survey Results: Core Biotechnology

4.1 Organisation background and relationships

Responses have been received from 93% of Core Biotechnology organisations.

Figure 19 Almost 50% of Core Biotechnology organisations were established later than 1999



Five organisations were formed in 2002.

Figure 20 Most Core Biotechnology organisations are located around the main centres

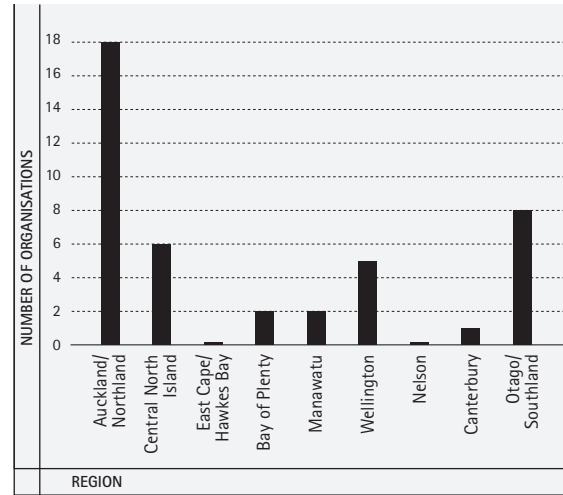


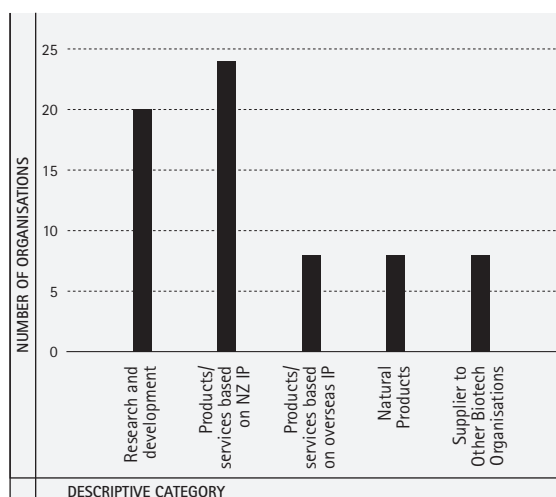
Table 5 Most Core Biotechnology organisations are predominantly NZ-owned

	NUMBER OF ORGANISATIONS	PERCENT
More than 70% NZ-owned	30	77%
More than 70% overseas-owned	5	13%
Other	4	10%

The four organisations in the "Other" category are 50/50 New Zealand/overseas-owned.

Organisations were asked to indicate descriptive categories that apply to them. Many ticked more than one category.

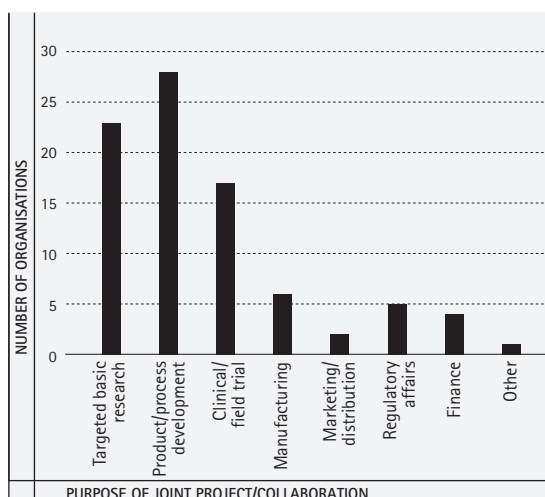
Figure 21 Most Core Biotechnology organisations are carrying out research and development and making products or services based on NZ-owned IP



4.1.1 Joint projects and collaborations

Of the 39 respondents, 35 reported a total of 203 joint projects or collaborations with other organisations.

Figure 22 Most collaborations involve research and development



Core Biotechnology organisations are forming collaborations with overseas organisations as well as organisations in New Zealand.

Table 6 Number of collaborations with different types of organisations in different countries

	NEW ZEALAND	AUSTRALIA	NORTH AMERICA	EUROPE/UK	OTHER
University	29	5	10	6	2
Other government-funded organisation	35	6	3	4	0
Private business	22	13	12	9	4
Public listed company	3	7	19	8	0

4.1.2 Product development

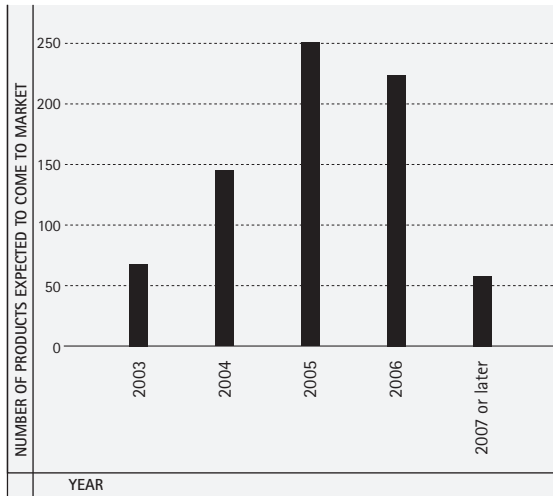
Many Core Biotechnology organisations are developing products with what they currently believe to be a relatively short time to market.

Table 7 Average time to bring product to market

	NUMBER OF ORGANISATIONS	PERCENT
Up to 2 years	7	18%
More than 2 and up to 5 years	18	47%
More than 5 and up to 10 years	7	18%
More than 10 years	6	16%

4 Capability Survey Results: Core Biotechnology

Figure 23 Core Biotechnology respondents expect to bring approximately 750 products to market over the next few years



4.1.3. Research and Intellectual Property

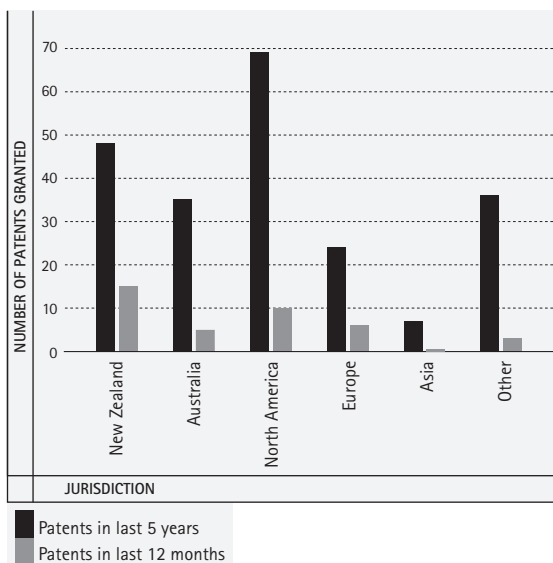
Of the 39 Core Biotechnology respondents, 30 reported that they are engaged in research and 25 indicated that they have applied for patents.

4.1.3.1 Patents

- 244 patents have been granted to Core Biotechnology organisations in the last five years, 83 in the Australasian jurisdictions and 69 in North America.
- 40 have been granted in the last 12 months.
- 694 patents have been filed but not yet granted.

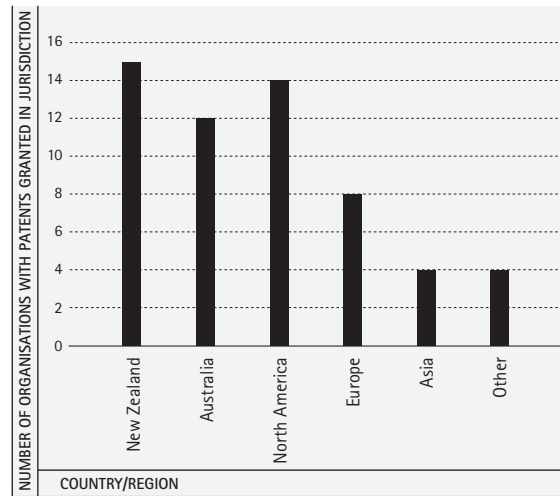
Numbers of patents do not reflect number of inventions, as many organisations file more than one patent on an invention and also do so in more than one jurisdiction.

Figure 24 Most patents are filed in Australasian and North American jurisdictions



Respondents did not indicate which jurisdictions were included in the "Other" category.

Figure 25 In the last five years, patents were granted to 17 Core Biotechnology organisations

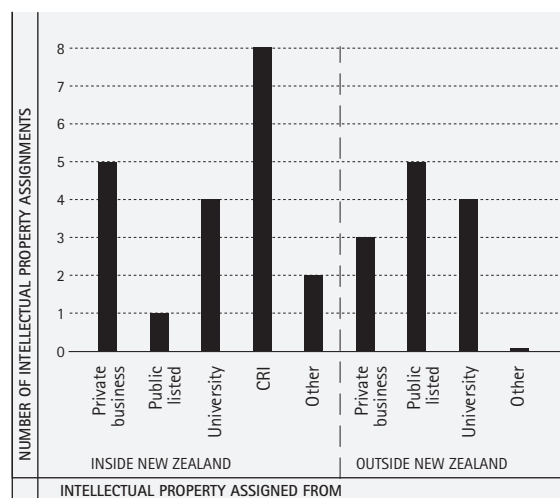


Over the last financial year, Core Biotechnology respondents spent a total of \$6.5 million on management of IP and patent applications.

4.1.3.2 Contracted Intellectual Property

Eighteen of the 39 respondents report acquisition of the contractual right to use intellectual property from another organisation.

Figure 26 Core Biotechnology organisations have acquired contractual rights to IP from a range of different types of organisations



4.1.3.3 Papers in refereed journals

Fifteen Core Biotechnology organisations have had a total of 64 biotechnology-related papers published in refereed journals.

4.2 Financial

4.2.1 Focus

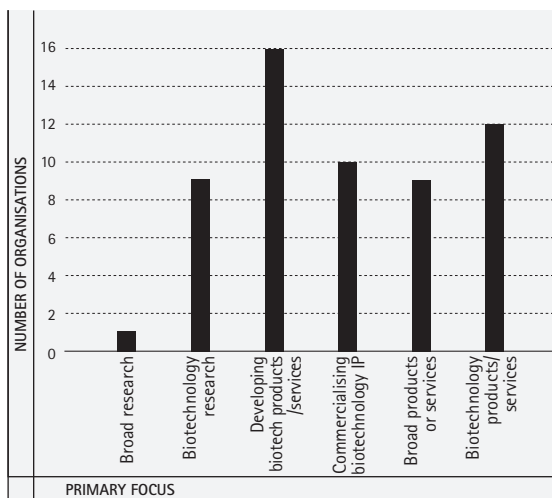
Organisations were asked to indicate their primary focus from up to two of the following categories:

- 1 Research organisation, broad focus including biotechnology.
- 2 Research organisation concentrating on biotechnology.
- 3 Research organisation developing specific biotechnology products or services.
- 4 Organisation commercialising biotechnology IP developed elsewhere.
- 5 Organisation producing and selling products or services, some biotechnology-related, some not.
- 6 Organisation producing and selling only biotechnology-related products or services.

Nineteen of the 39 respondents selected two categories. Of the 19,

- Six selected categories 2 and 3.
- Four selected categories 4 and 6.
- Three selected categories 3 and 4.
- Two selected categories 4 and 5.

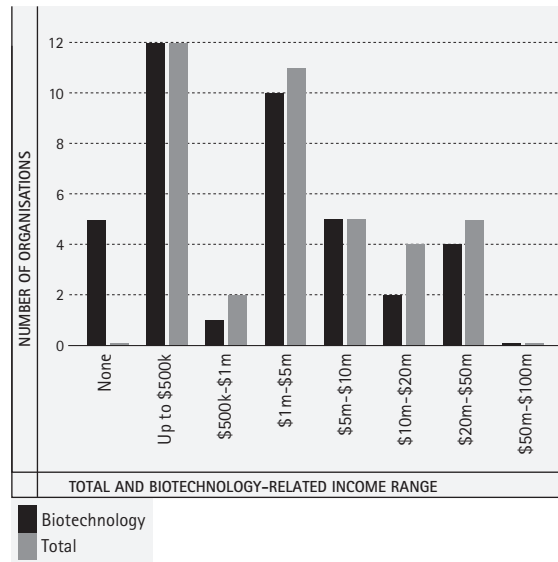
Figure 27 Core Biotechnology organisations are focused on biotechnology research as well as development of products and services



4.2.2 Income

Five Core Biotechnology organisations report no biotechnology-related income in the last financial year. Most of the total income reported by these organisations came from investment funding.

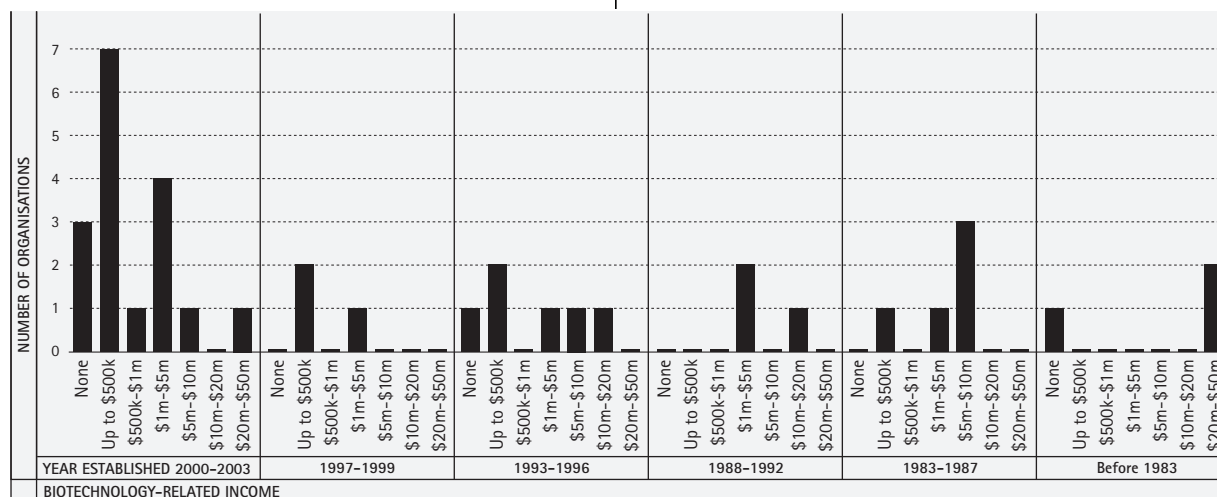
Figure 28 Most Core Biotechnology organisations report less than \$5m total income over the last financial year.



4 Capability Survey Results: Core Biotechnology

We might expect to see recently established biotechnology organisations with low biotechnology-related income. However, even some older organisations report biotechnology-related income less than \$1 million in the last financial year.

Figure 29 Not all Core Biotechnology organisations with low biotechnology-related income are recent start-ups



4.2.2.1 Sources of biotechnology-related income

Organisations were asked to indicate the percentage of biotechnology-related income that came from the following sources:

- 1 Licensing agreements (including milestone payments) on biotechnology products still in development.
- 2 Sale of biotechnology-related IP.
- 3 Government funding (including grants) for biotechnology-related projects.
- 4 Sale (to distributors or customers) of biotechnology-related products made by your New Zealand organisation.
- 5 Royalty payments received for biotechnology-related processes used or products developed from IP owned by your organisation
- 6 Biotechnology-related services

Table 8 Fourteen Core Biotechnology respondents report more than 80% of total income from sale of biotechnology-related products

NUMBER OF CORE BIOTECHNOLOGY ORGANISATIONS REPORTING BIOTECHNOLOGY-RELATED INCOME AS...							
Source of biotechnology-related income	...less than 5% total income	...5%-10% total income	...11%-20% total income	...21%-40% total income	...41%-60% total income	...61%-80% total income	...more than 80% total income
Licensing	0	1	0	1	0	0	0
IP sales	0	0	0	0	0	0	0
Government	4	3	1	0	3	0	3
Product sales	2	1	0	0	3	1	14
Royalties	2	0	1	0	0	0	0
Services	3	1	0	2	3	0	1
Total	11	6	2	3	9	1	18

Biotechnology-related government funding represents more than 40% of total income for six respondents.

4.2.3 Exports

Of the 39 Core Biotechnology respondents, 18 reported export income. In total, respondents reported around \$123 million in export income over the last financial year. Several respondents indicated a range rather than a number, and the actual figure may lie between \$120 million and \$126 million.

Figure 30 Most Core Biotechnology organisations export less than \$5m per year

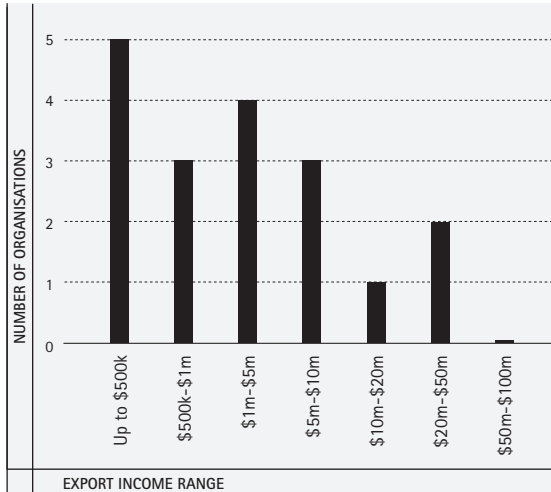


Figure 31 Core Biotechnology organisations export primarily to Australia, Europe and North America

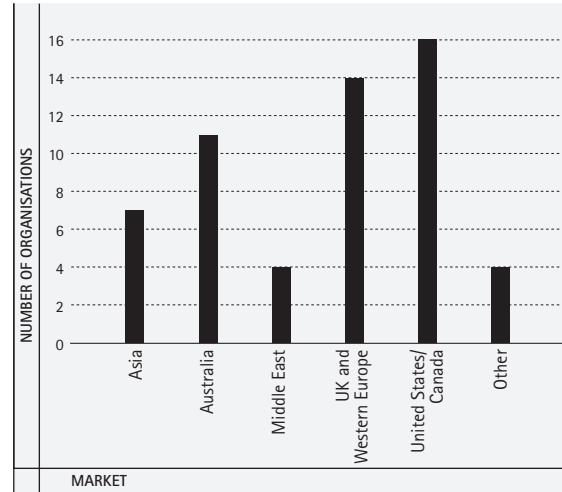
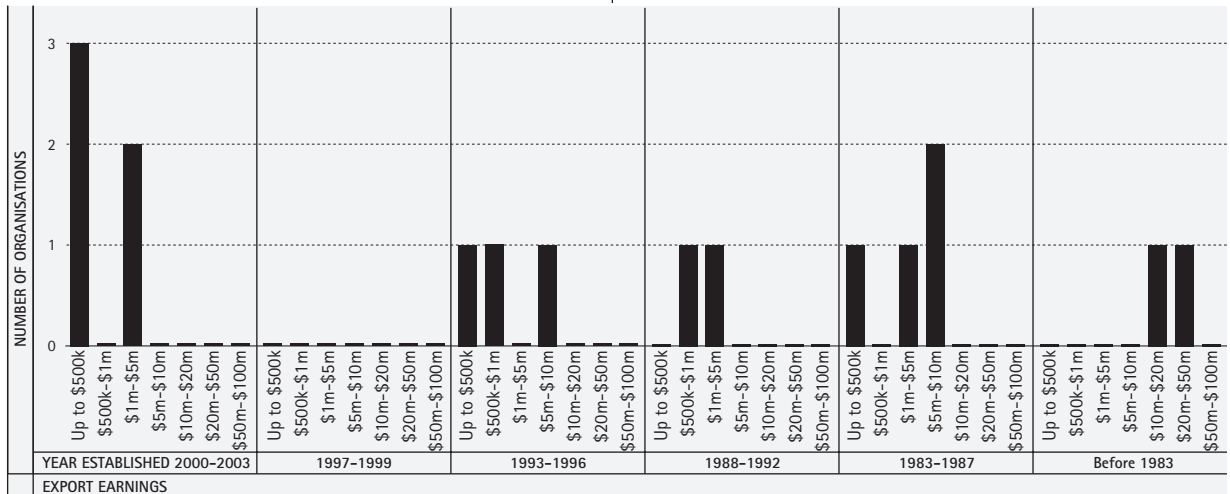
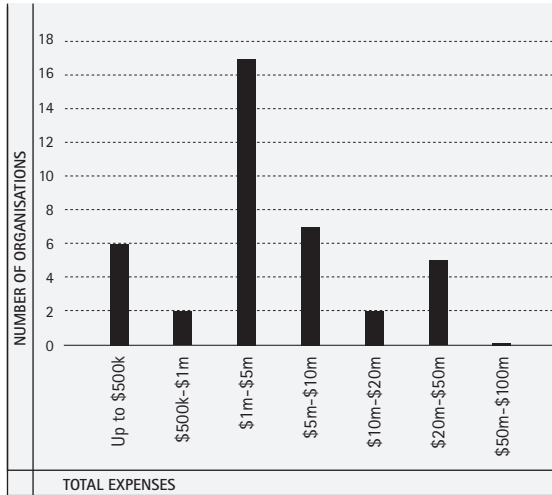


Figure 32 More mature Core Biotechnology organisations tend to have higher levels of export earnings



4.2.4 Operating expenses

Figure 33 Most Core Biotechnology organisations report total expenses below \$10m in the last financial year



Nine respondents report total expenses higher than total income for the last financial year.

4.2.4.1 Regulatory costs

Core Biotechnology organisations spent a total of \$6.1 million on regulatory costs in the last financial year.

Most individual organisations spent less than \$500,000 on regulatory costs, but one respondent spent \$600,000 and one spent \$2 million.

4.2.5 Capital expenditure

4.2.5.1 Equipment

Respondents spent a total of \$10.7 million on equipment in the last financial year.

Table 9 Twelve Core Biotechnology respondents spent more than \$100k on capital equipment in the last financial year

	NUMBER OF ORGANISATIONS
Up to \$100k	14
Over \$100k up to \$500k	8
Over \$500k up to \$1m	3
More than \$1m	1

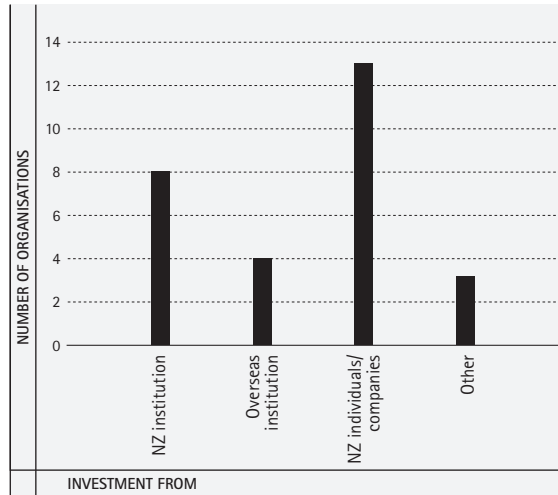
4.2.5.2 Facilities

Thirteen respondents spent a total of \$3.8 million on specialised facilities and premises. Three of these spent more than \$500,000.

4.2.6 Investment

Fourteen Core Biotechnology reported receiving investment capital during the last financial year.

Figure 34 Core Biotechnology organisations received investment capital primarily from NZ institutions, private individuals and companies

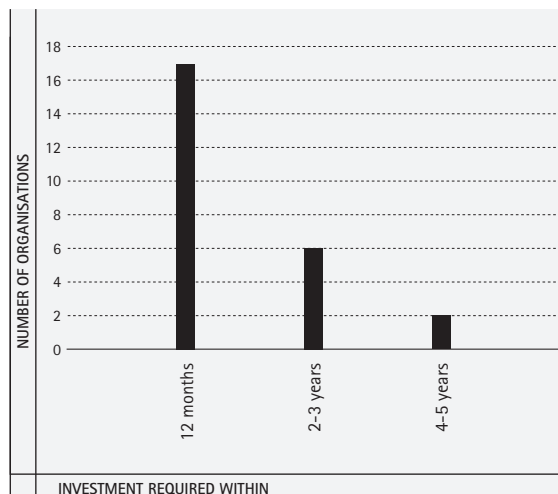


The "Other" category includes parent company and CRI investment.

4.2.6.1 Future investment requirements

Twenty five respondents indicated that they intend to raise more biotechnology-related investment capital over the next few years.

Figure 35 Seventeen Core Biotechnology organisations indicated their intention to raise more capital over the next 12 months



4.3 Staff

Core Biotechnology organisations report a total of around 1,200 staff. Around 75% of staff are directly involved in biotechnology-related activities such as research, product development or manufacture, IP management, bioinformatics, or management of biotechnology staff and processes.

4.3.1 Qualifications

Table 10 Core Biotechnology respondents report employment of 641 staff with some form of tertiary qualification.

QUALIFICATION	RESEARCH	PRODUCTS AND SERVICES	MANAGEMENT	TOTAL
Doctorate	111	20	33	164
Master's degree	83	22	22	127
Bachelor's degree	102	113	50	265
Diploma/Certificate	25	46	12	83
Other	0	2	0	2
Total	321	203	117	641

Individuals included in "Other" were not specified.

Figure 36 More than 50% of staff with doctorates and master's degrees are employed in research

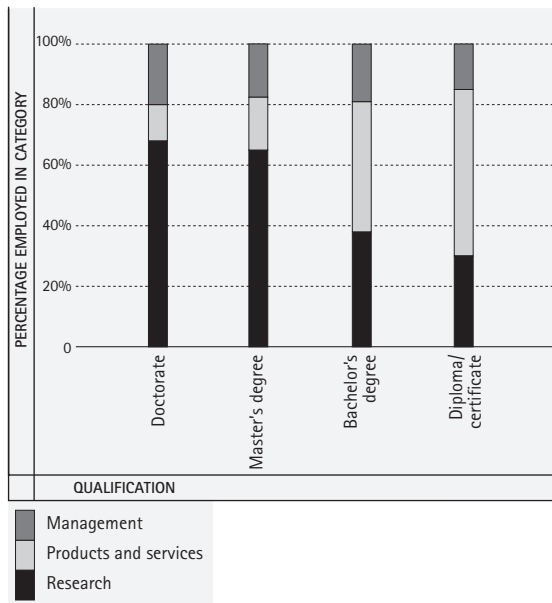
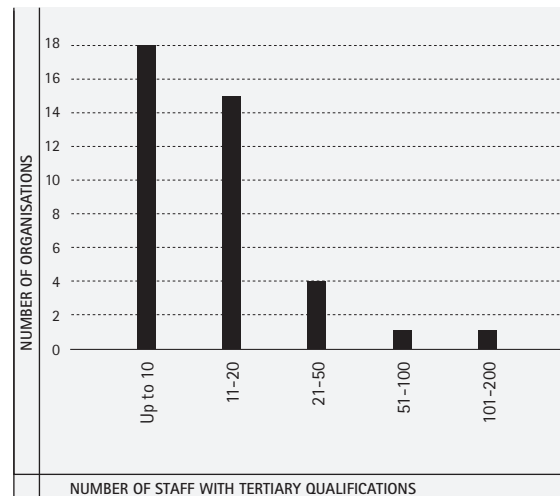


Figure 37 Most Core Biotechnology organisations employ fewer than 20 staff with tertiary qualifications



4 Capability Survey Results: Core Biotechnology

4.3.2 Future requirements for staff with tertiary qualifications

Over the next two years, assuming that organisational growth meets their expectations, Core Biotechnology respondents are predicting a 38% increased need for staff with tertiary qualifications. Over the next five years, the predicted increase is 84%.

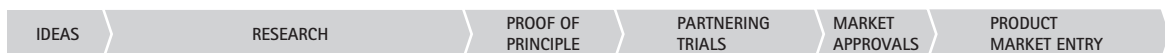
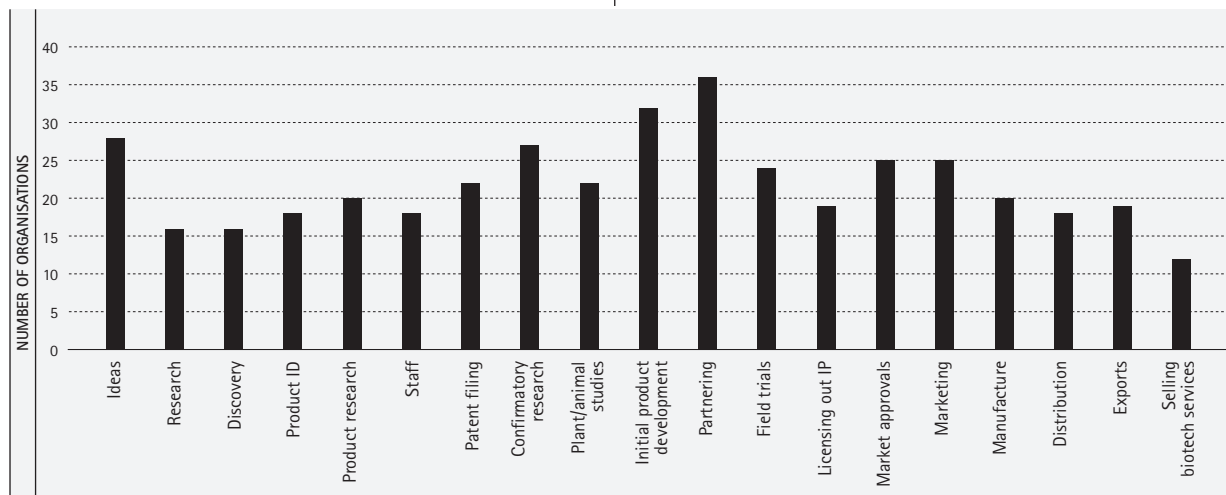
Table 11 Core Biotechnology respondents predict that they will require more than 500 new staff with tertiary qualifications over the next five years

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	164	57	135	299
Master's degree	127	65	131	258
Bachelor's degree	265	79	179	444
Diploma/Certificate	83	41	94	177
Other	2			
Total	641	242	539	1,178

4.4 Capabilities

Organisations were asked to indicate their capabilities from a list of 19, arranged in order of the biotechnology value chain.

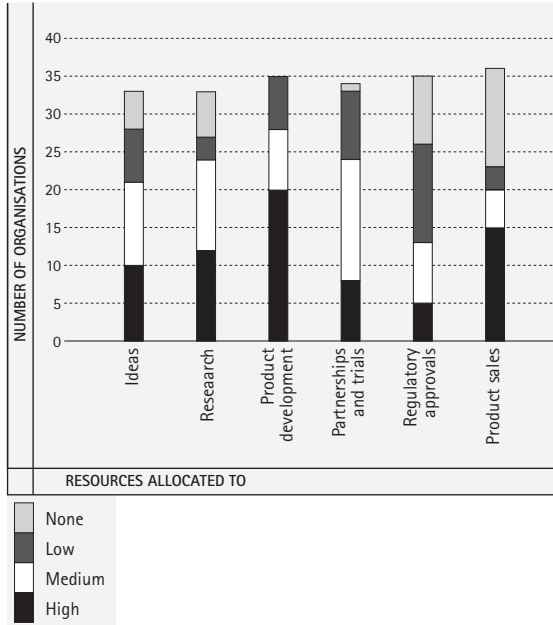
Figure 38 Most Core Biotechnology organisations indicate that they are good at ideas, confirmatory research, product development and partnering



4.4.1 Resources

Organisations were asked to assign a level of importance to each of the six parts of the biotechnology value chain, to indicate where in the value chain they concentrate their resources.

Figure 39 Thirty five Core Biotechnology organisations allocate high levels of resources to product development and sales, but another 13 are not focusing on sales at all

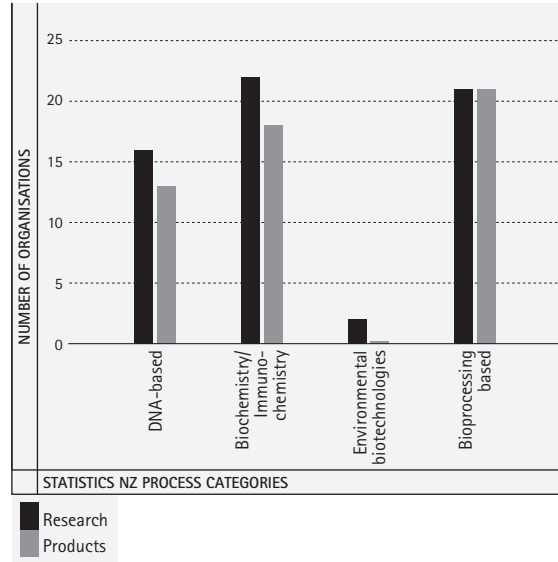


4.5 Products

4.5.1 Processes

Four process categories were identified by the Statistics Department in their biotechnology survey in 1989/99. Organisations were asked to indicate which of these processes they used in research and in products or services.

Figure 40 Core Biotechnology respondents use DNA-based, biochemical and bioprocessing methods in both research and product manufacture



4.5.2 Products on the market and under development

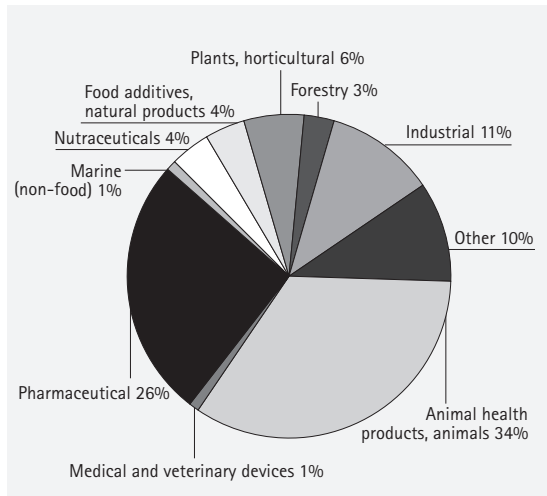
Organisations were asked for the number and type of products they currently have on the market, and the number and type they have under development. This section of the questionnaire was not filled out as completely as other sections:

- Three respondents indicated the types of products but did not give numbers. We have assumed the number in each case to be one.
- Three respondents declined to provide any information on products because of commercial sensitivity.

From the data provided, Core Biotechnology respondents report 204 products on the market and 180 under development.

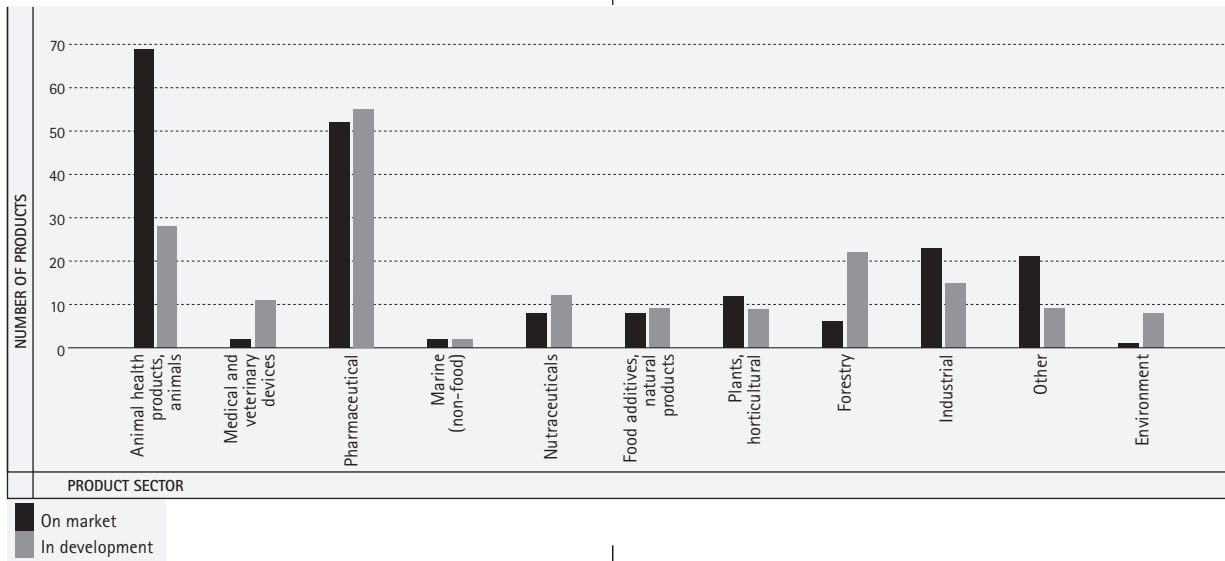
4 Capability Survey Results: Core Biotechnology

Figure 41 60% of products on the market from Core Biotechnology respondents are pharmaceutical or animal health products



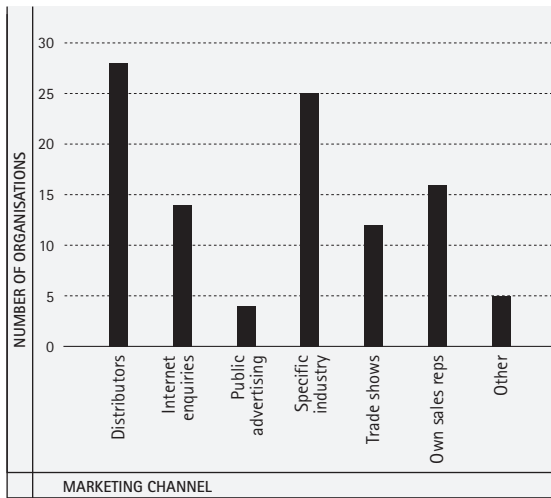
The "Other" category includes some cosmetic ingredients and biochemical intermediary compounds.

Figure 42 Products under development indicate some shift in emphasis from animal health to forestry products



4.5.3 Marketing channels

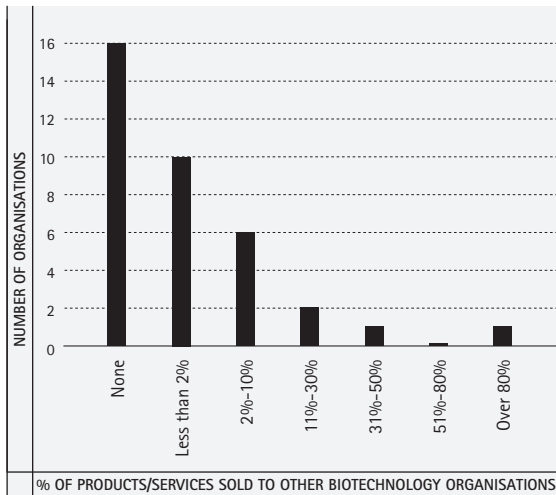
Figure 43 Most Core Biotechnology organisations intend to market products mainly through distributors or dealing directly with a specific industry



The "Other" category includes:

- Sale of IP through research and development collaborations.
- "Piggy-backing" on existing high-profile brands.
- Word of mouth.

Figure 44 Few Core Biotechnology organisations provide products or services to other biotechnology organisations



5 Capability Survey Results: Other Biotechnology

This category includes product-focused biotechnology organisations and a small number of pharmaceutical companies and organisations developing medical and veterinary devices.

5.1 Organisation background and relationships

Responses were received from 18 out of 26 organisations.

Figure 45 Most respondents were established more than 10 years ago.

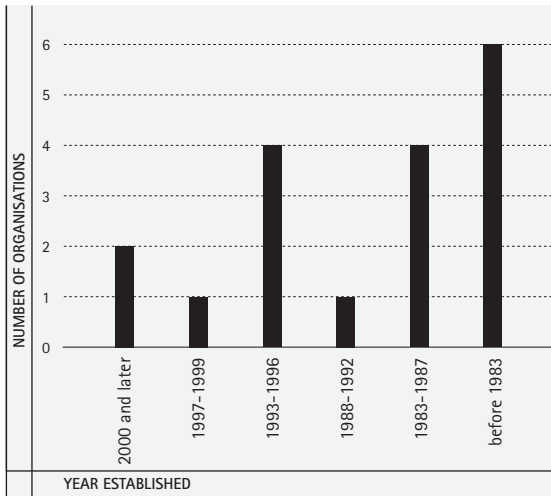
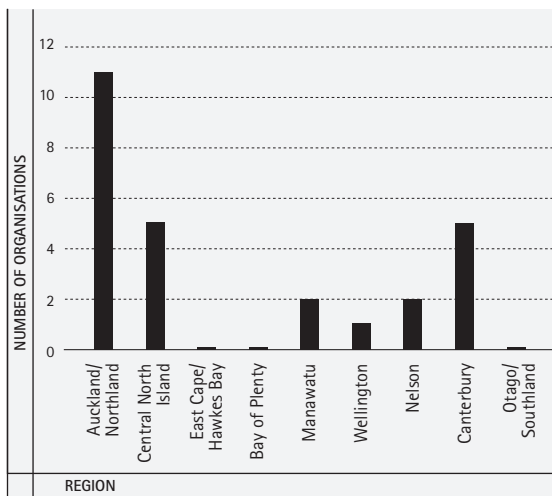


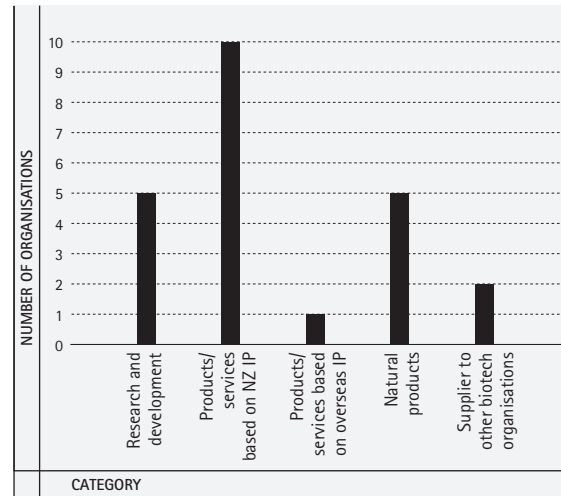
Figure 46 The 26 Other Biotechnology organisations are mostly located in Auckland, Central North Island and Canterbury



Fourteen respondents are New Zealand-owned, the other four are overseas-owned.

Organisations were asked to indicate descriptive categories that apply to them. Most ticked more than one category.

Figure 47 Most respondents are producing goods or services based on NZ IP



5.1.1 Joint projects and collaborations

Twelve respondents indicated that they were engaged in collaborations with other organisations.

Figure 48 Most collaborations involve R&D or marketing and product distribution

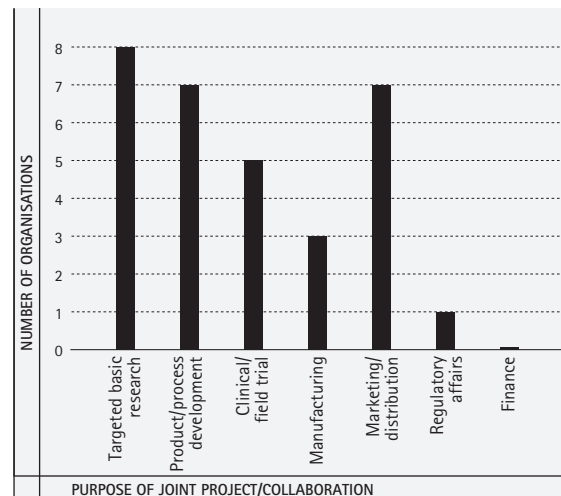
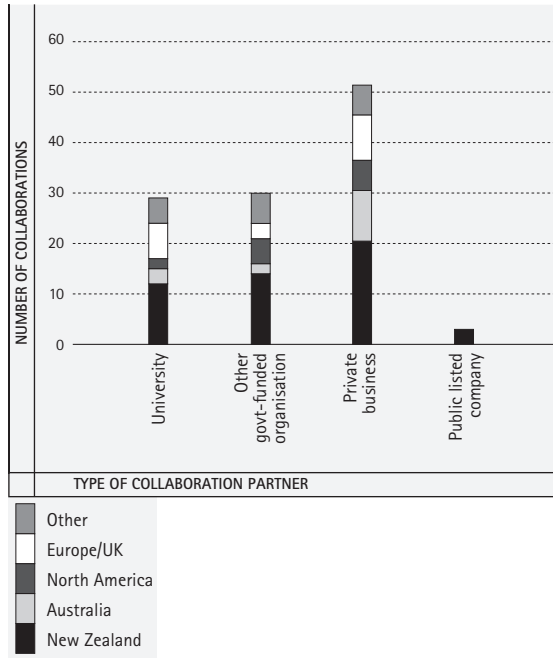


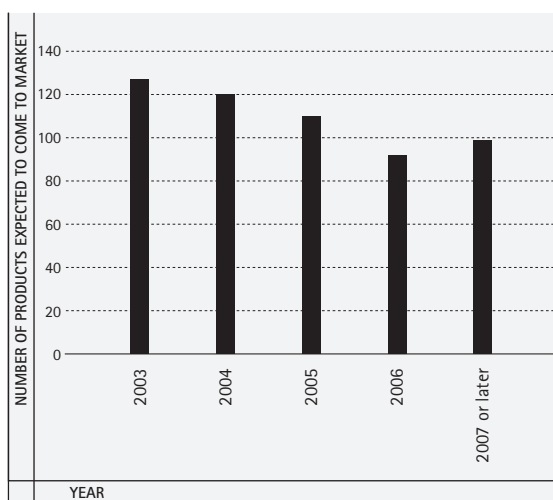
Figure 49 44% of collaborations are with NZ organisations, and overall 46% are with private businesses



5.1.2 Product development

Most respondents report an average product development time of two to five years. Overall, respondents expect to bring more than 540 products to market over the next few years.

Figure 50 More than 240 products are expected to come to market in the next two years



5.1.3 Research and Intellectual Property

Of the 18 Other Biotechnology respondents, 15 reported that they are engaged in research and 11 indicated that they have applied for patents.

Six respondents have had a total of 36 biotechnology-related publications in the last 12 months.

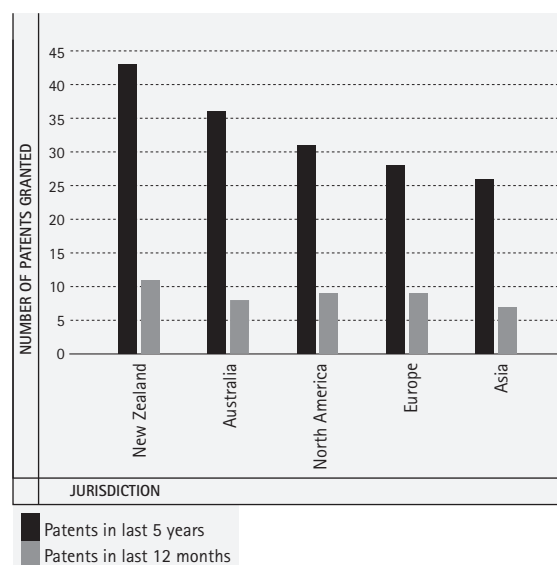
5.1.3.1 Patents

- 164 patents have been granted to respondents in the last five years, 79 in Australasian jurisdictions.
- 44 have been granted in the last 12 months.
- 23 patents have been filed but not yet granted.

Patent numbers exclude a large number reported by a multinational pharmaceutical company with operations in New Zealand.

Numbers of patents do not reflect number of inventions, as many organisations file patents on an invention in more than one jurisdiction.

Figure 51 Respondents file some patents in all jurisdictions

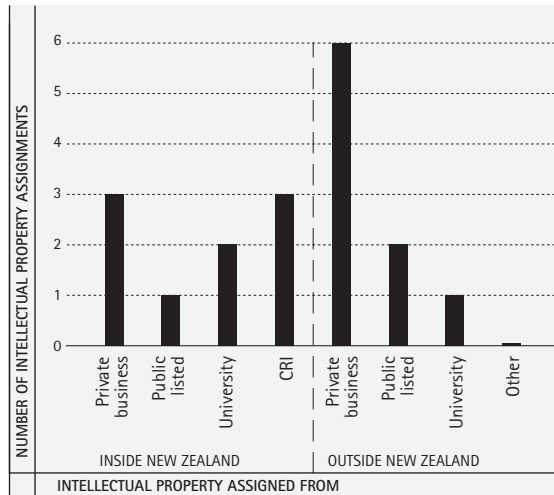


Over the last financial year, respondents spent a total of \$2.5 million on management of Intellectual Property and patent applications.

5.1.3.2 Contracted Intellectual Property

Nine of the 18 respondents report acquisition of the contractual right to use IP from another organisation.

Figure 52 Half of reported IP assignments are from NZ organisations



5.1.3.3 Papers in refereed journals

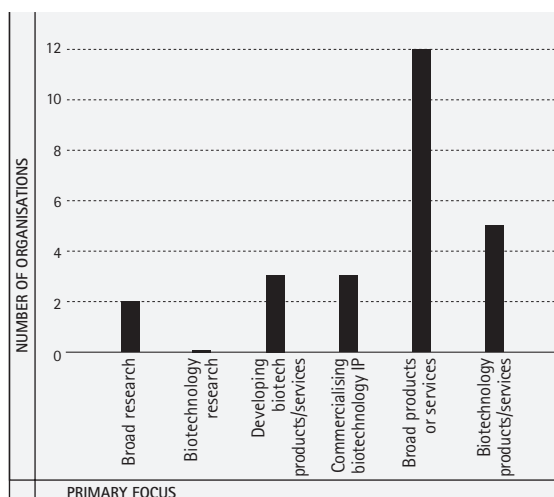
Seven respondents published a total of 36 papers in refereed journals in the last 12 months.

5.2 Financial

5.2.1 Focus

Organisations were asked to indicate their primary focus from a list of categories.

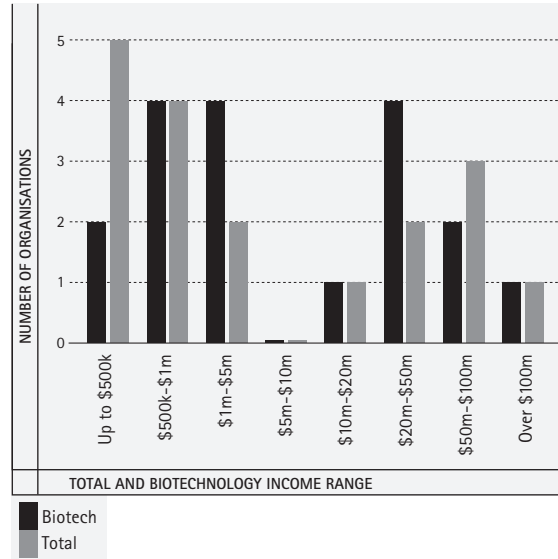
Figure 53 Most respondents indicate a strong focus on products and services



5.2.2 Income

Most of the biotechnology-related income reported by respondents came from sales of products and services.

Figure 54 Respondents report a wide range of biotechnology-related income levels



Thirteen of the 18 respondents report more than 80% of their income from biotechnology-related sources. Two respondents report less than 5% of their income from biotechnology.

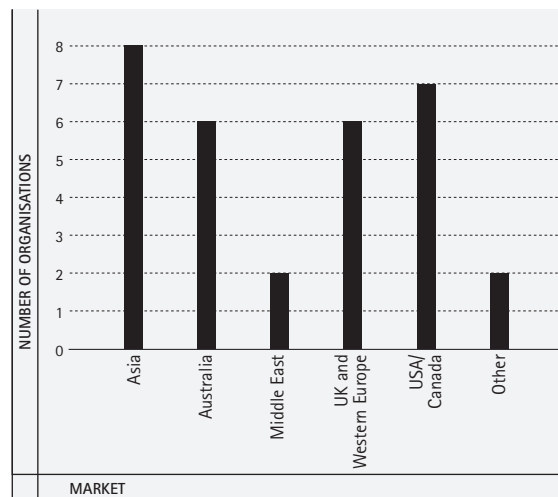
5.2.3 Exports

Of the 18 Other Biotechnology respondents, 11 reported export income with a total of around \$52.7 million over the last financial year. Several respondents indicated a range rather than a number, and the actual figure may lie between \$47 million and \$58 million.

Three of the 11 earn more than \$5 million export income per year, and five earn less than \$1 million.

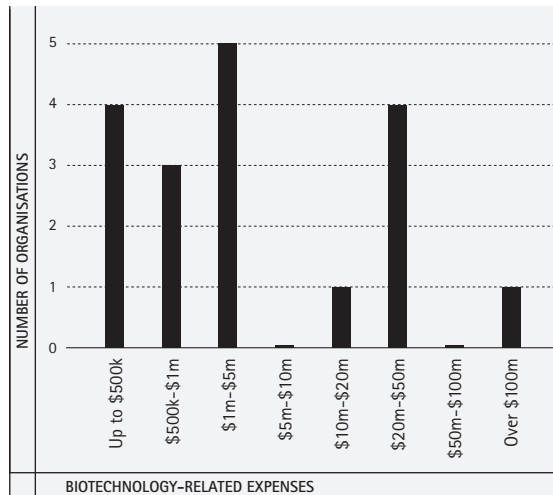
One respondent declined to provide any information on export income.

Figure 55 Respondents export to a range of overseas markets



5.2.4 Operating expenses

Figure 56 70% of respondents report biotechnology-related expenses of less than \$5 million



Two respondents report biotechnology-related expenses significantly higher than biotechnology-related income in the last financial year.

One respondent declined to provide any information on expenses.

5.2.4.1 Regulatory costs

Respondents spent a total of \$2.6 million on regulatory costs in the last financial year.

Most individual organisations spent less than \$500,000 on regulatory costs, but one respondent spent more than \$1 million.

One respondent declined to provide any information on regulatory costs.

5.2.5 Capital expenditure

5.2.5.1 Equipment

Respondents spent a total of \$3.3 million on equipment in the last financial year. Most spent less than \$500,000; two spent more than \$700,000.

5.2.5.2 Facilities

Respondents spent a total of \$4.2 million on specialised facilities and premises. One spent more than \$2 million.

One respondent declined to provide any information on equipment and facility costs.

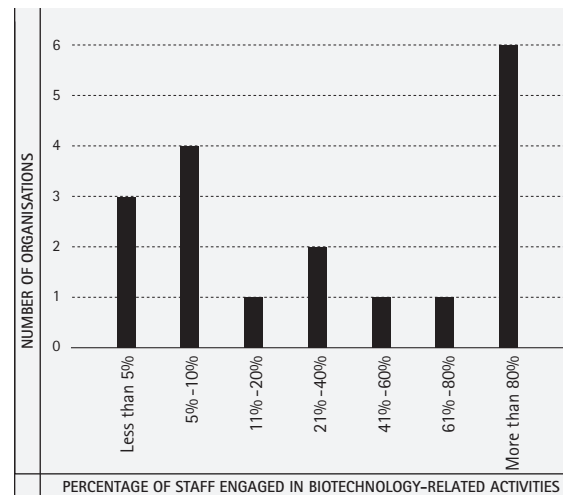
5.2.6 Investment

Four respondents received investment capital in the last financial year, two from overseas institutions and two from New Zealand private individuals or companies. Seven indicated their intention to raise investment capital within the next three years.

5.3 Staff

The 18 Other Biotechnology respondents employ a total of 11,500 staff, but only 317 are engaged on biotechnology-related activities.

Figure 57 Seven respondents have less than 10% of staff engaged in biotechnology, six have more than 80% in biotechnology



5 Capability Survey results: Other Biotechnology

5.3.1 Qualifications

Of the 317 staff engaged in biotechnology-related activities, 311 hold tertiary qualifications.

Table 12 Most staff with tertiary qualifications are engaged in research

QUALIFICATION	RESEARCH	PRODUCTS AND SERVICES	MANAGEMENT	TOTAL
Doctorate	56	4.5	5.5	66
Master's degree	35	4	6	45
Bachelor's degree	88	25	14	127
Diploma/Certificate	62	6	5	73
Total	241	39.5	30.5	311

5.3.2 Future requirements for staff with tertiary qualifications

Over the next two years, assuming that organisational growth meets their expectations, Other Biotechnology respondents are predicting a 20% increased need for staff with tertiary qualifications. Over the next five years, the predicted increase is 48%.

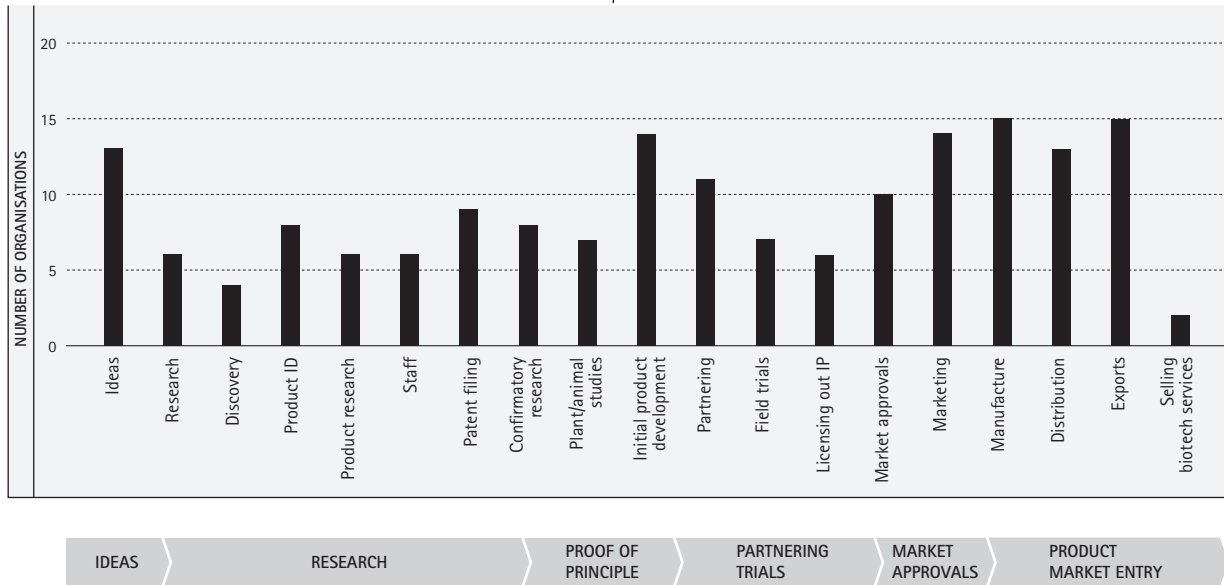
Table 13 Respondents predict that they will need more than 140 new staff with tertiary qualifications over the next five years

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	66	10	21	87
Master's degree	45	21	46	91
Bachelor's degree	127	14	39	166
Diploma/Certificate	73	17	43	116
Total	311	62	149	460

5.4 Capabilities

Organisations were asked to indicate their capabilities from a list of 19, arranged in order of the biotechnology value chain.

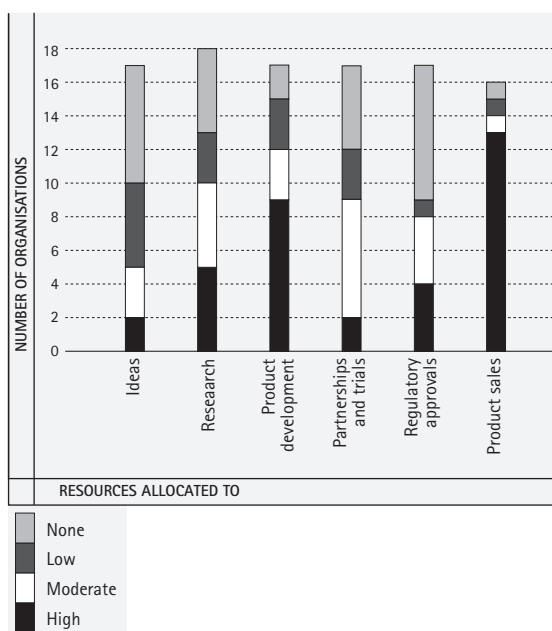
Figure 58 Most Other Biotechnology respondents report product development and marketing/manufacturing capabilities



5.4.1 Resources

Organisations were asked to assign a level of importance to each of the six parts of the biotechnology value chain, to indicate where in the value chain they concentrate their resources.

Figure 59 Most Other Biotechnology respondents allocate high levels of resources to product development and sales

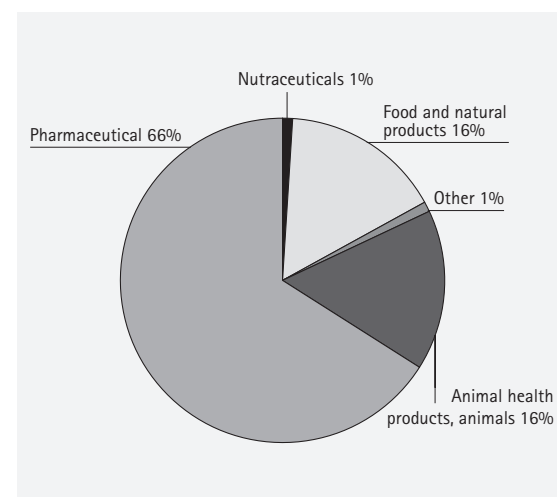


5.5 Products

5.5.1 Products on the market and under development

Respondents report 1,328 products currently on the market, and 108 under development.

Figure 60 98% of products are pharmaceutical, animal health, or food/natural products

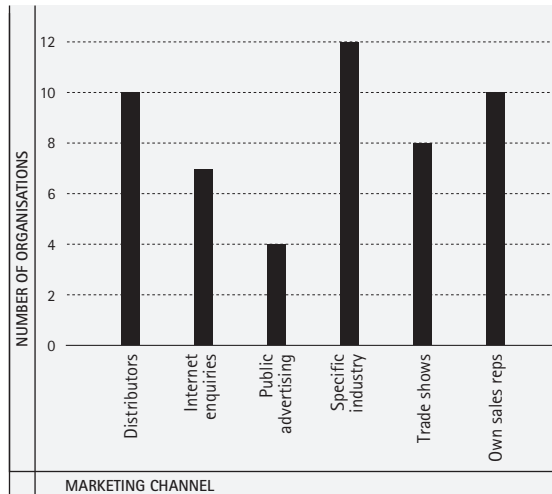


Most of the 108 products under development are animal health or pharmaceutical products.

5 Capability Survey Results: Other Biotechnology

5.5.2 Marketing channels

Figure 61 Other Biotechnology respondents use a range of different marketing channels



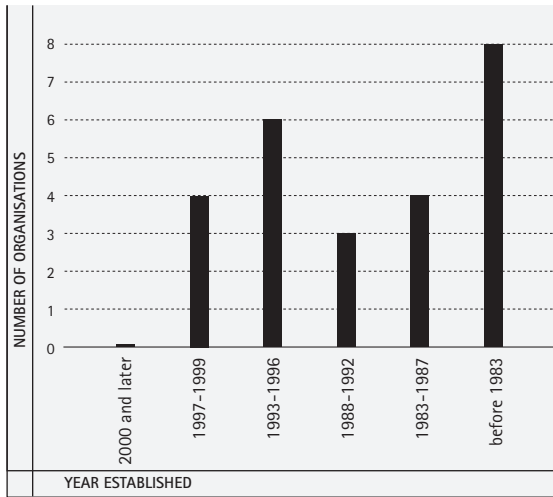
More than half of the Other Biotechnology respondents do not supply products or services to biotechnology organisations. Only two respondents supply more than 50% of their products to biotechnology organisations.

6 Capability Survey Results: Natural Products

6.1 Organisation background and relationships

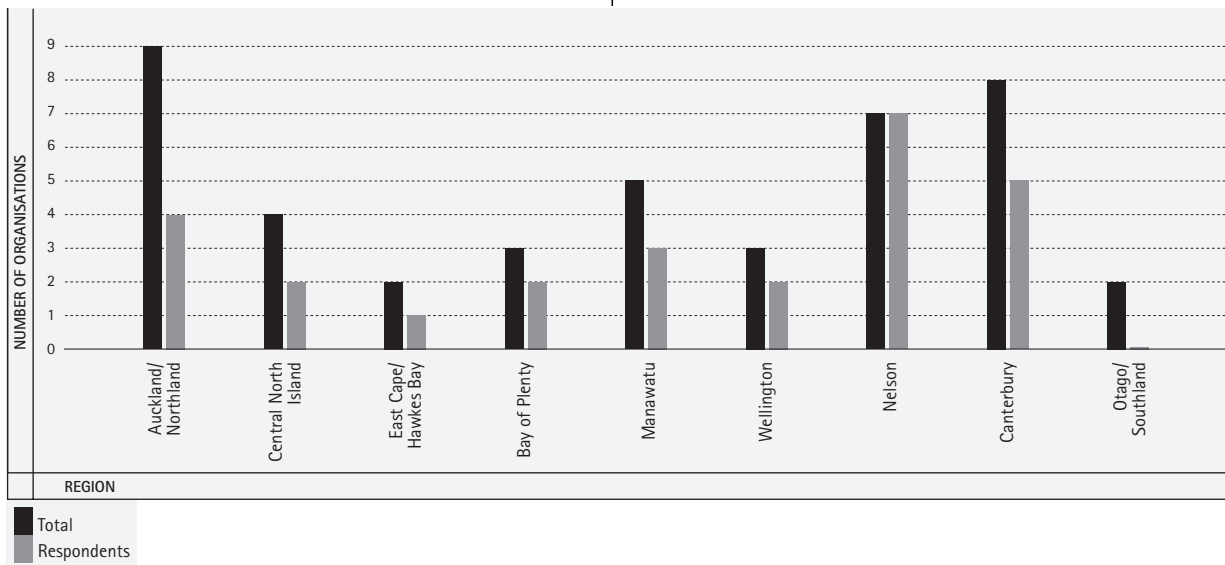
Responses have been received from 26 Natural Products organisations.

Figure 62 Most respondents are more than 10 years old



One respondent did not provide a establishment date.

Figure 63 Most respondents are located in Auckland, Nelson or Canterbury



One respondent is overseas-owned, two are 50/50 New Zealand and overseas-owned. The rest are New Zealand-owned.

6 Capability Survey Results: Natural Products

Organisations were asked to indicate descriptive categories that apply to them. Many ticked more than one category.

Figure 64 Most respondents describe themselves as Natural Products organisations, but some are also involved in R&D and supply to other biotech organisations

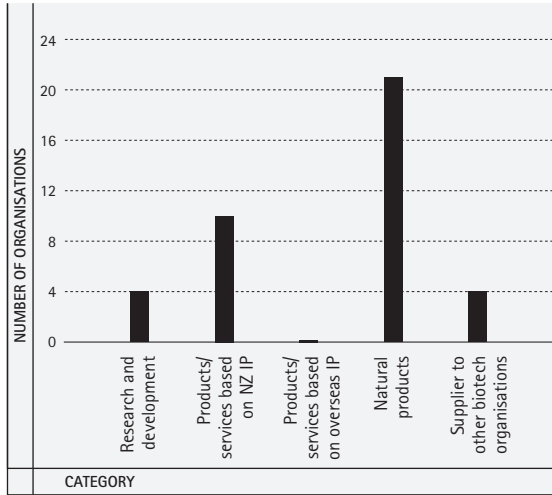
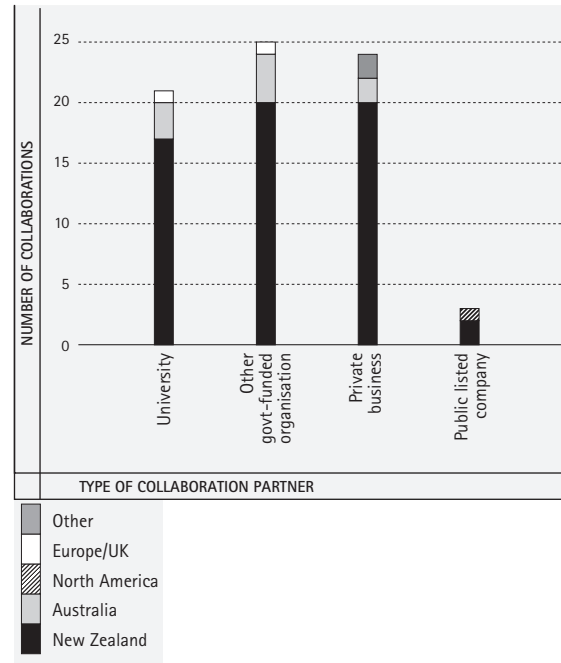


Figure 66 Most collaborations reported are with other NZ organisations

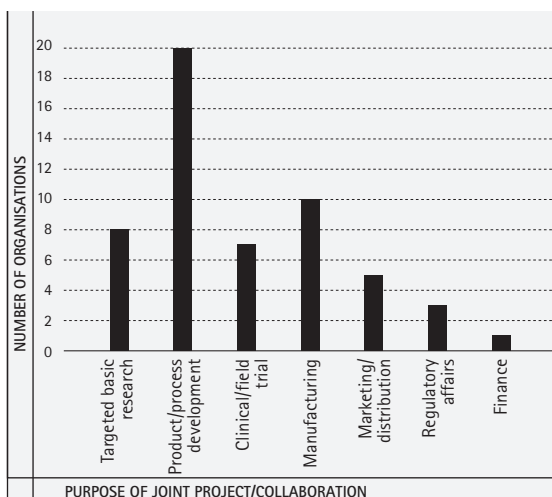


Note: CRIs are included under other government-funded organisations.

6.1.1 Joint projects and collaborations

Of the 26 respondents, 21 reported a total of 140 joint projects or collaborations with other organisations.

Figure 65 Most collaborations involve product development or manufacturing



6.1.2 Product development

Most Natural Products respondents are developing products with a short expected time to market.

Figure 67 Most products have a development time of less than two years

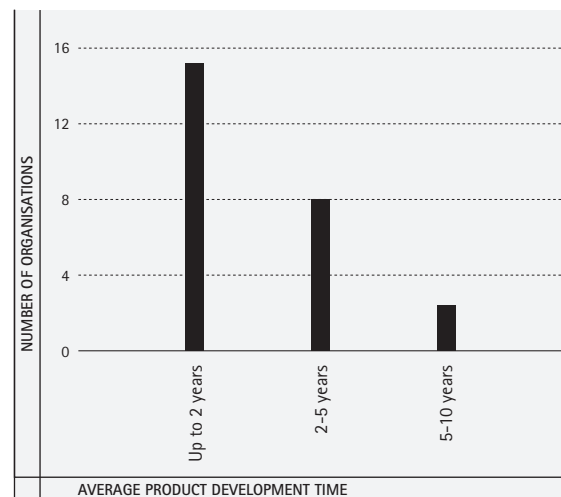
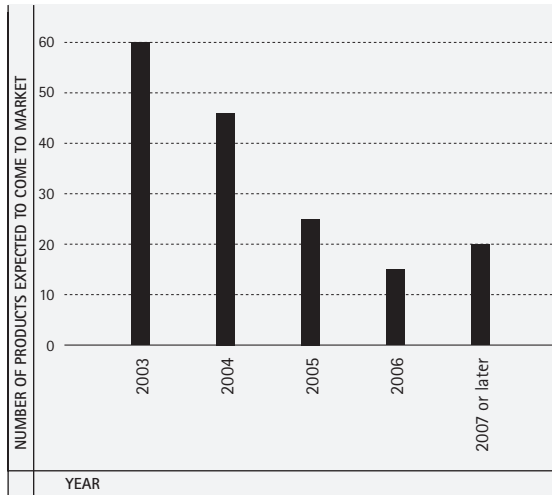


Figure 68 Respondents expect to bring more than 160 new products to market in the next few years



One respondent indicated that 10 new products are expected to come to market, but did not indicate when.

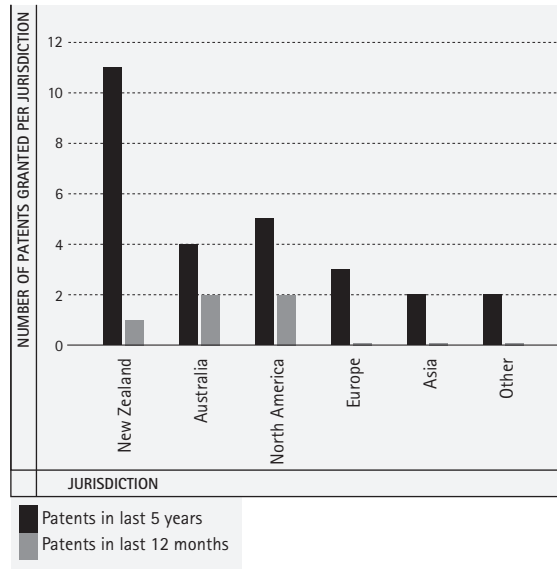
6.1.3 Research and Intellectual Property

Of the 26 Natural Products respondents, 18 reported that they are engaged in research and six indicated that they have applied for patents.

6.1.3.1 Patents

Twenty seven patents have been granted in the last five years, five of these in the last 12 months. Seven have been filed but are not yet granted.

Figure 69 Most patents are filed in NZ



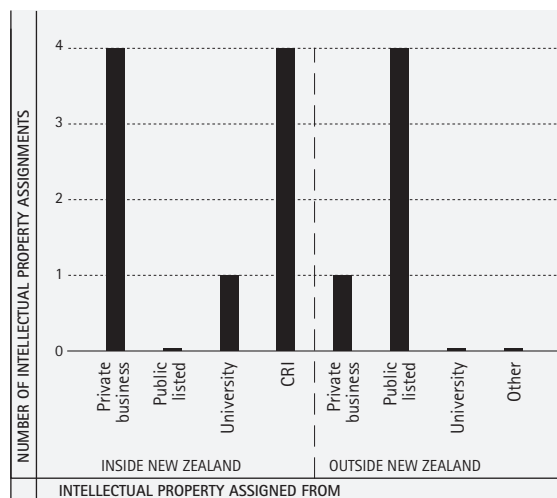
Two respondents have filed patents in all jurisdictions.

In the last financial year, respondents spent \$356,000 on management of IP and patent applications.

6.1.3.2 Contracted Intellectual Property

Twelve of the 26 respondents report acquisition of the contractual right to use IP from another organisation.

Figure 70 Private NZ companies, CRIs and overseas public listed companies are the main collaboration partners for Natural Products respondents



6.1.3.3 Papers in refereed journals

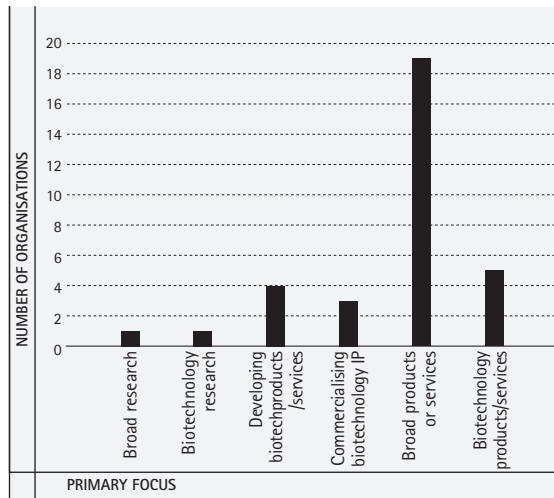
Three respondents have had eight biotechnology-related papers published in refereed journals over the last 12 months.

6.2 Financial

6.2.1 Focus

Organisations were asked to indicate their primary focus from a list of categories.

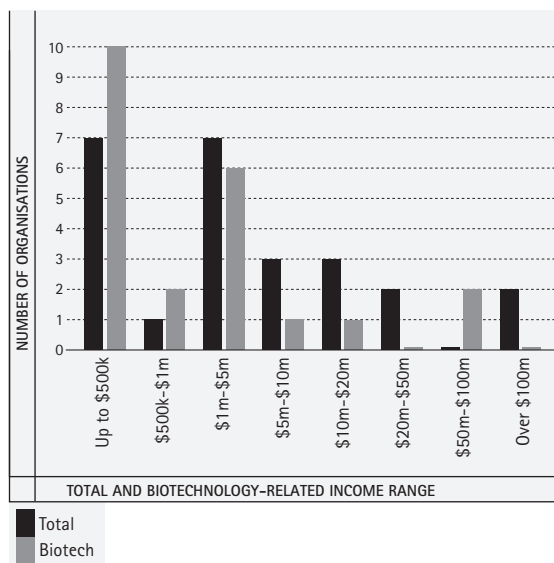
Figure 71 Most respondents indicated a strong focus on broad products or services



6.2.2 Income

Fifteen respondents report total income less than \$5 million in the last financial year, and 18 report biotechnology-related incomes below \$5 million.

Figure 72 Fifteen respondents report total income below \$5m



Thirteen respondents report that more than 80% of their income is biotechnology-related.

Most of the biotechnology-related income reported by these organisations came from product sales, some from government grants and sale of biotechnology-related services.

6.2.3 Export income

Of the 26 respondents, 15 reported export of products. Two declined to provide any information on export income.

The 13 respondents who did provide information indicate a total export income of around \$17.8 million over the last financial year. Several respondents indicated a range rather than a number, and the actual figure may lie between \$15 million and \$21 million.

Figure 73 Most respondents report less than \$500k biotechnology-related export income

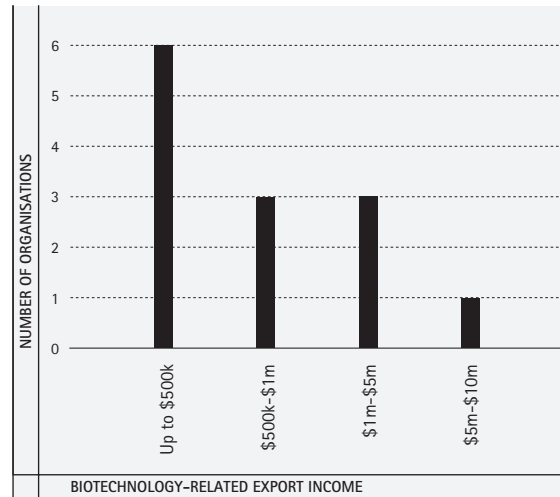
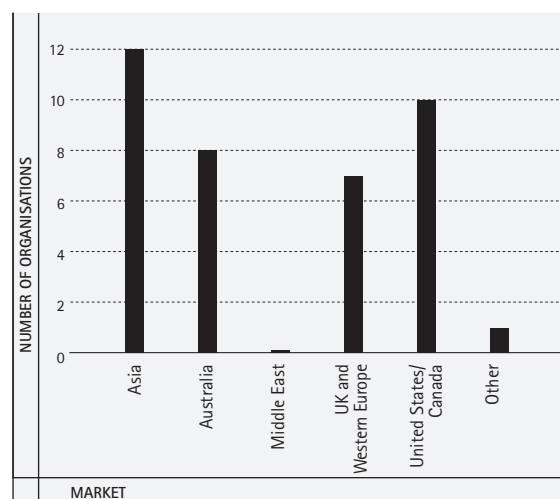
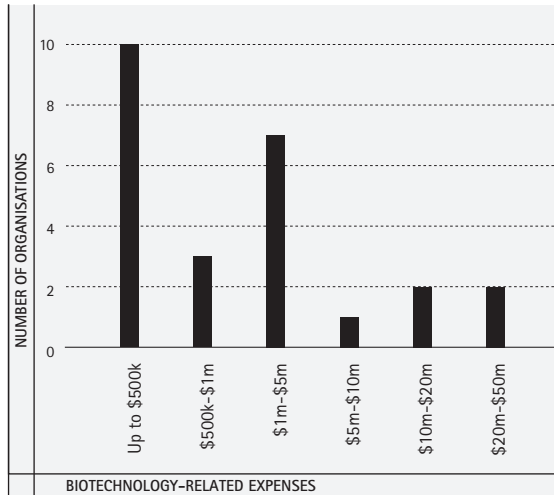


Figure 74 Asia and North America are the main export markets for Natural Products respondents



6.2.4 Operating expenses

Figure 75 Most respondents report biotechnology-related expenses less than \$5 million



One respondent declined to provide any information on expenses.

6.2.4.1 Regulatory costs

Respondents spent \$1.1 million on regulatory costs in the last financial year.

6.2.5 Capital expenditure

In the last financial year, respondents reported spending:

- \$10 million on biotechnology-related equipment
- \$337,000 on specialised facilities.

6.2.6 Investment

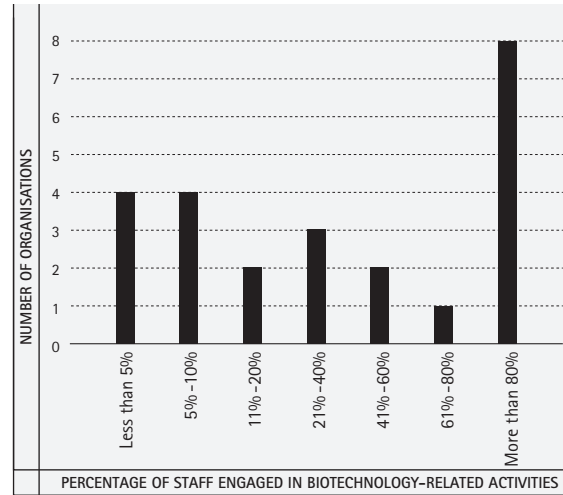
Six respondents reported receiving investment capital during the last financial year, four from New Zealand private individuals or companies and two from New Zealand institutions.

Twelve indicated intentions to raise investment funds in the future, six within 12 months and six within two to three years.

6.3 Staff

Natural Products respondents employ 1,413 staff, 333 of whom are engaged in biotechnology-related activities.

Figure 76 Ten respondents have less than 20% of staff working in biotechnology, eight have more than 80% in biotechnology



6 Capability Survey Results: Natural Products

6.3.1. Qualifications

Table 14 32% of respondents' staff engaged in biotechnology-related activities have tertiary qualifications

QUALIFICATION	RESEARCH	PRODUCTS AND SERVICES	MANAGEMENT	TOTAL
Doctorate	5	1	5	11
Master's degree	6	7	7	20
Bachelor's degree	11	17	24	52
Diploma/Certificate	4	11	10	25
Total	26	36	46	108

Forty three percent of staff with tertiary qualifications are employed in management positions.

6.3.2 Future requirements for staff with tertiary qualifications

Over the next two years, assuming that organisational growth meets their expectations, Natural Products respondents are predicting a 14% increased need for staff with tertiary qualifications. Over the next five years, the predicted increase is 70%.

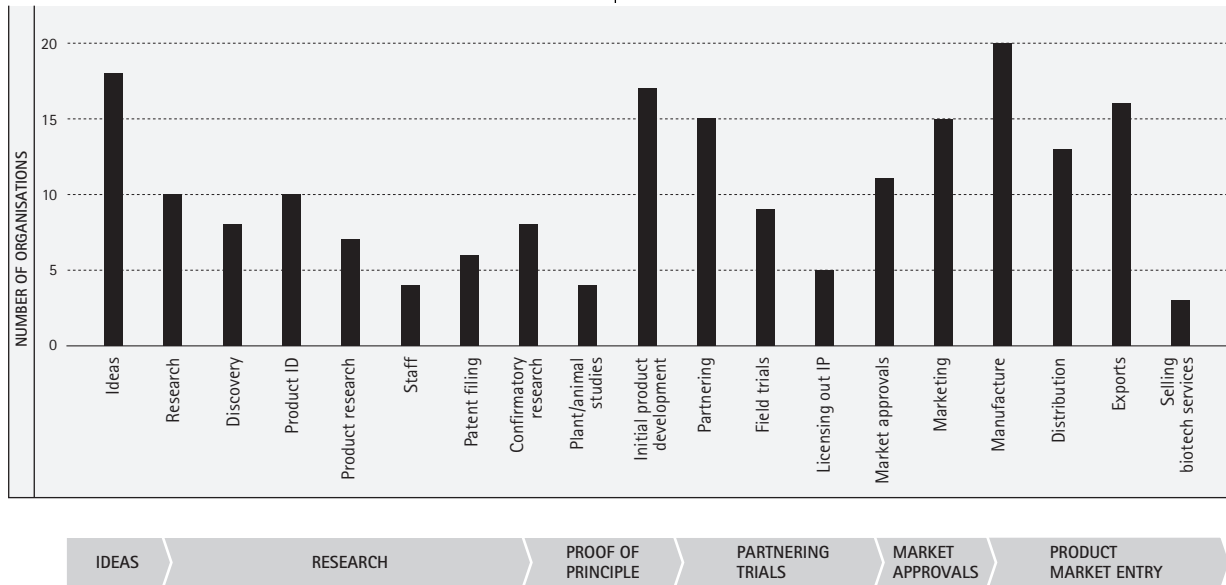
Table 15 Natural Products respondents predict that they will require more than 180 new staff with tertiary qualifications over the next five years

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	11	4	13	24
Master's degree	20	3	12	32
Bachelor's degree	52	2	27	79
Diploma/Certificate	25	6	24	49
Total	108	15	76	184

6.4 Capabilities

Organisations were asked to indicate their capabilities from a list of 19, arranged in order of the biotechnology value chain.

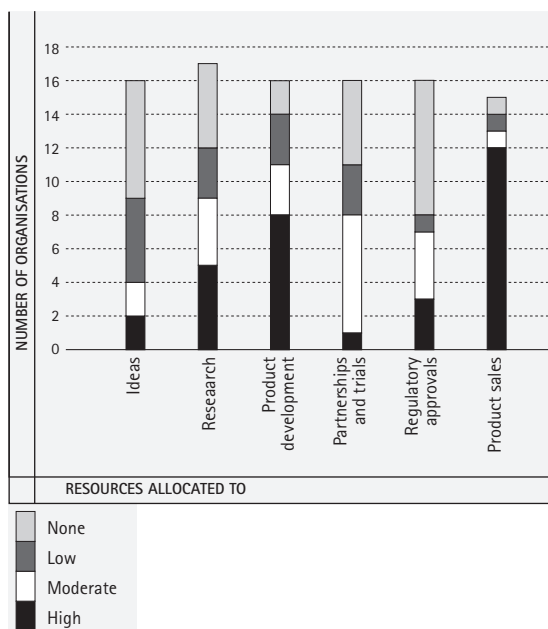
Figure 77 Most Natural Products respondents indicate capabilities in product development and product manufacture and sales



6.4.1 Resources

Organisations were asked to assign a level of importance to each of the six parts of the biotechnology value chain, to indicate where in the value chain they concentrate their resources.

Figure 78 Natural Products respondents allocate resources mostly to product development and sales



6.5 Products

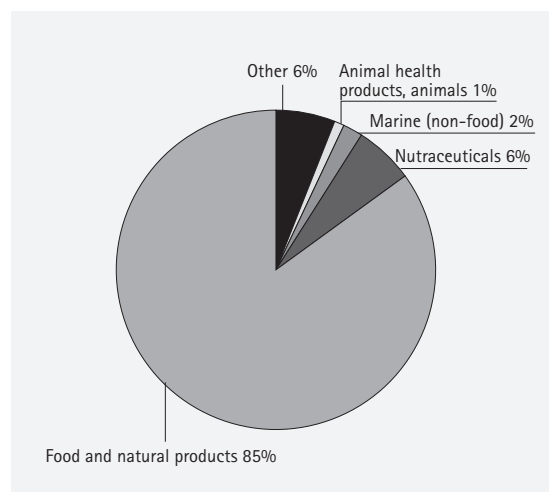
6.5.1 Processes

Natural Products respondents mostly use bioprocessing processes in research and product manufacture.

6.5.2 Products on the market and under development

Respondents report 514 products currently on the market, and 132 under development.

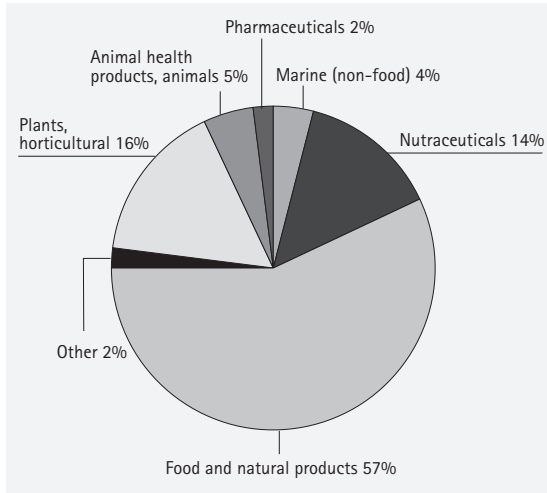
Figure 79 85% of products on the market are food/natural products



The "Other" category includes cosmetics and food processing products.

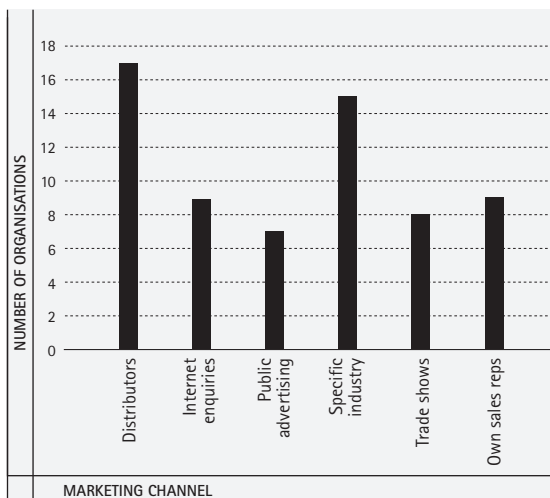
6 Capability Survey Results: Natural Products

Figure 80 Products under development are more diverse



6.5.3 Marketing channels

Figure 81 Most Natural Products respondents market products mainly through distributors or dealing directly with a specific industry



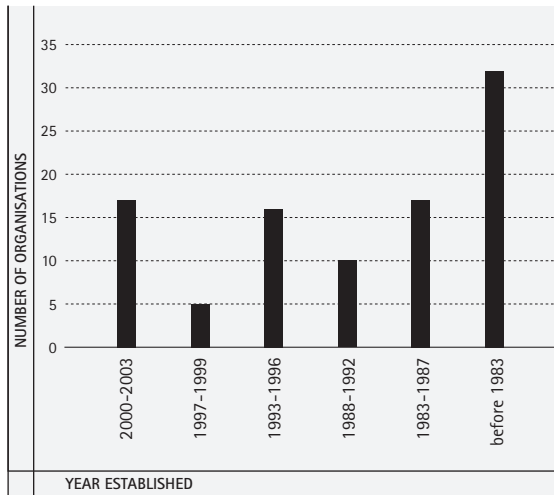
Nine respondents supply a small percentage of their products or services to biotechnology organisations.

7 Capability Survey Results: Suppliers to the Industry

7.1 Organisation background and relationships

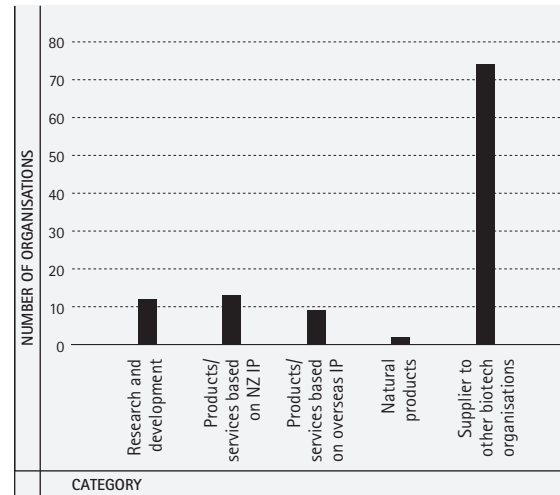
Ninety eight Supplier organisations responded to the survey questionnaire.

Figure 82 Seventeen of the 98 respondents were established in the last two years.



Organisations were asked to indicate descriptive categories that apply to them. Many ticked more than one category.

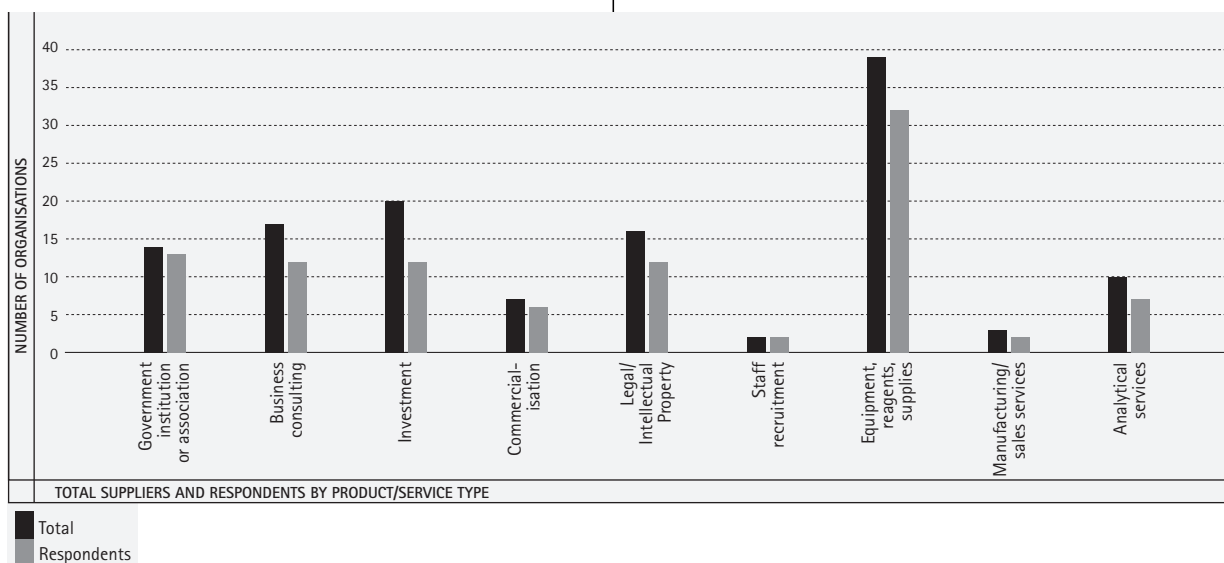
Figure 83 Most respondents describe themselves as Suppliers, but some are also carrying out research and product development



7.1.1 Types of Supplier organisations

The respondents provide a wide range of goods and services to the biotechnology industry.

Figure 84 Responses were received from a broad range of Supplier organisations



7.1.2 Research and Intellectual Property

Twenty eight of the respondents reported that they were carrying out research into new products or ideas, and 11 had filed patents.

The respondents published a total of 59 articles or papers in a refereed journal in the last 12 months.

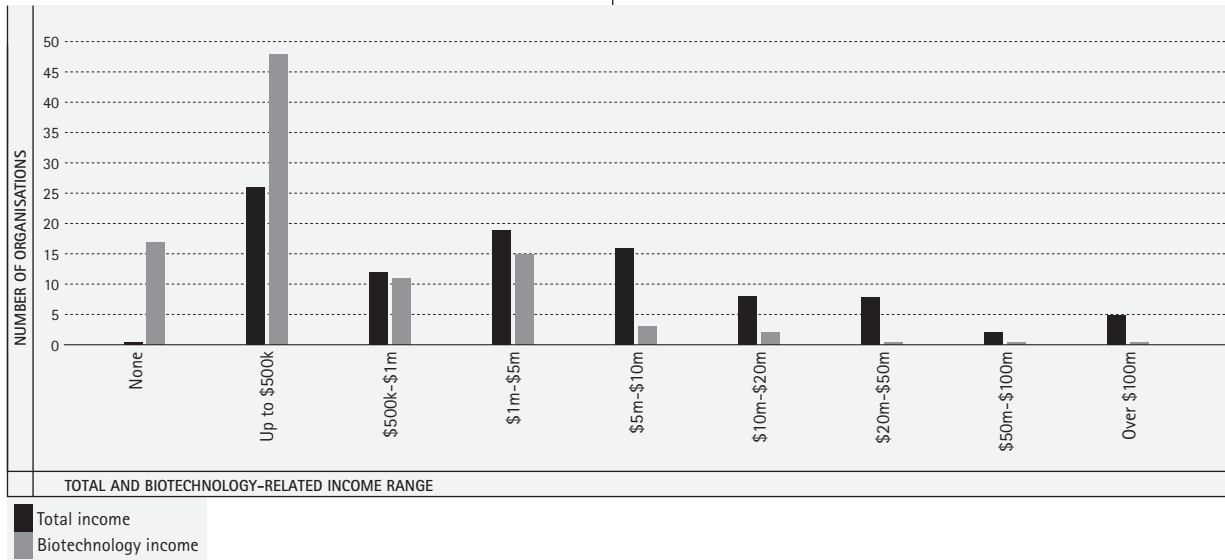
7.2 Financial

There are many small-to-medium size Suppliers to the biotechnology industry.

One Supplier declined to provide any financial information.

7.2.1 Income

Figure 85 Approximately 50% of Supplier respondents reported total incomes below \$5m and biotechnology-related incomes below \$500k



7.2.2 Export income

Nineteen Supplier respondents report export income of \$30.4 million from biotechnology-related products and services.

Three respondents indicated that they earn some export income, but declined to provide detailed information.

Figure 86 Most Supplier respondents receive only small amounts of biotechnology-related export income

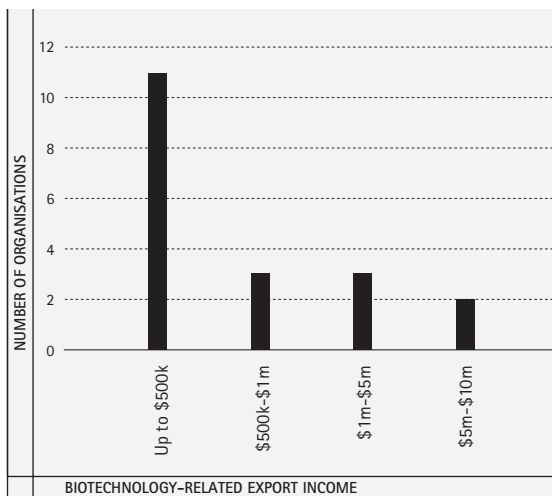
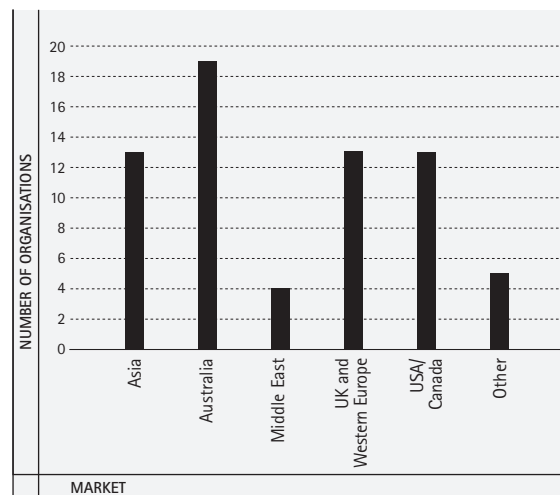


Figure 87 Suppliers export to a wide range of markets

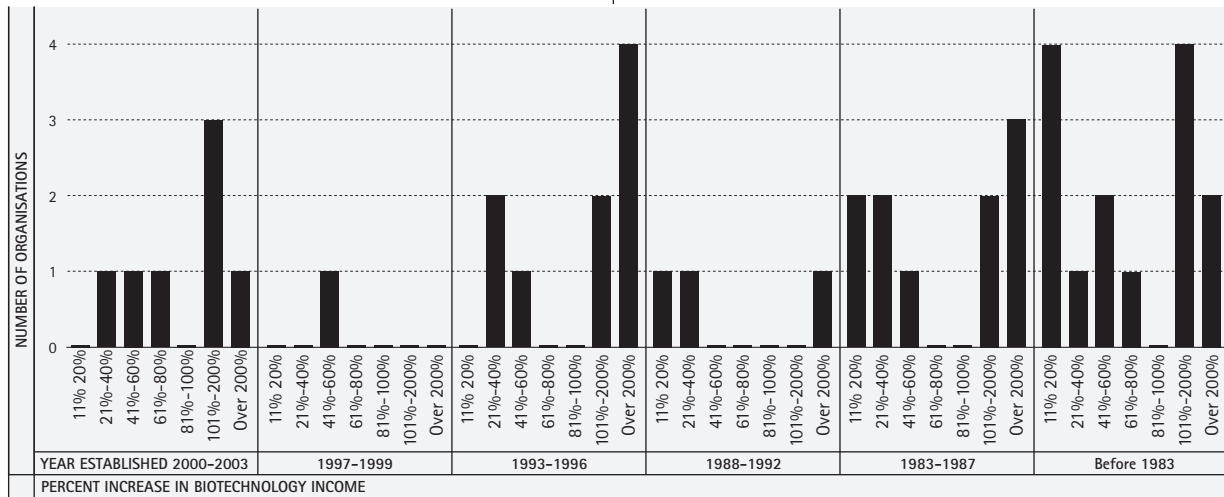


The "Other" category includes Scandinavia, Pacific Islands, and South Africa.

7.2.3 Changes in biotechnology-related income

Fifty one of the 98 respondents reported an increase in biotechnology-related income in the last five years, and some have reported very large increases. A significant number of organisations are less than five years old, and large percentage income increases from these organisations would be expected. However, some older Supplier organisations are also reporting large percentage increases in biotechnology-related income.

Figure 88 Only five of the respondents reporting large percentage income increases were established after 1997

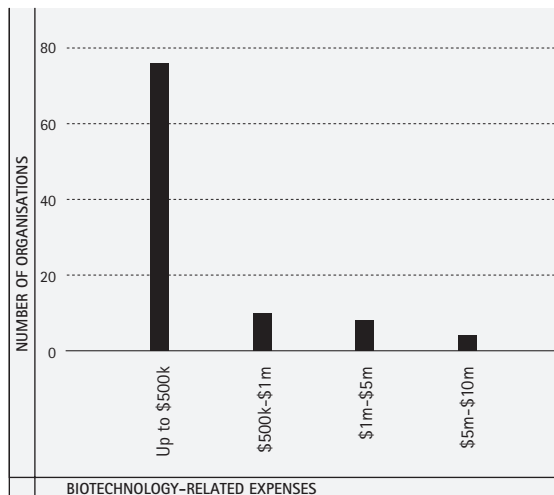


Many of the large percentage increases were reported by Suppliers with lower levels of biotechnology-related income. However, eight organisations with biotechnology-related annual income greater than \$1 million reported percentage increases higher than 100% over the past five years.

No respondents reported decreases in biotechnology-related income over the past five years. Twenty five respondents reported no significant change.

7.2.4 Biotechnology-related expenses

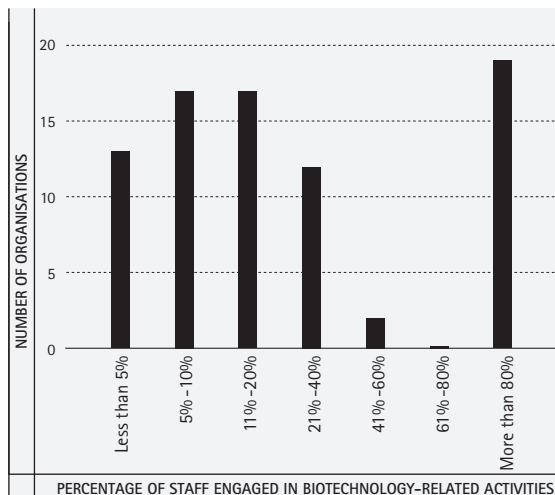
Figure 89 Most Supplier respondents report biotechnology-related expenses below \$500k



7.3 Staff

Respondents employ a total of 8,185 staff, with 471 (just 6%) employed in biotechnology-related activities.

Figure 90 Less than 20% of total staff in many Supplier organisations are working on biotechnology-related activities. However, 19 Supplier organisations employ more than 80% of their staff in biotechnology



Most of the organisations with more than 80% of staff working in biotechnology have fewer than 20 total staff. Three have between 20 and 45 total staff.

7 Capability Survey Results: Suppliers to the Industry

7.3.1 Qualifications and future staff requirements

93% of staff working for Supplier respondents in biotechnology-related activities have tertiary qualifications.

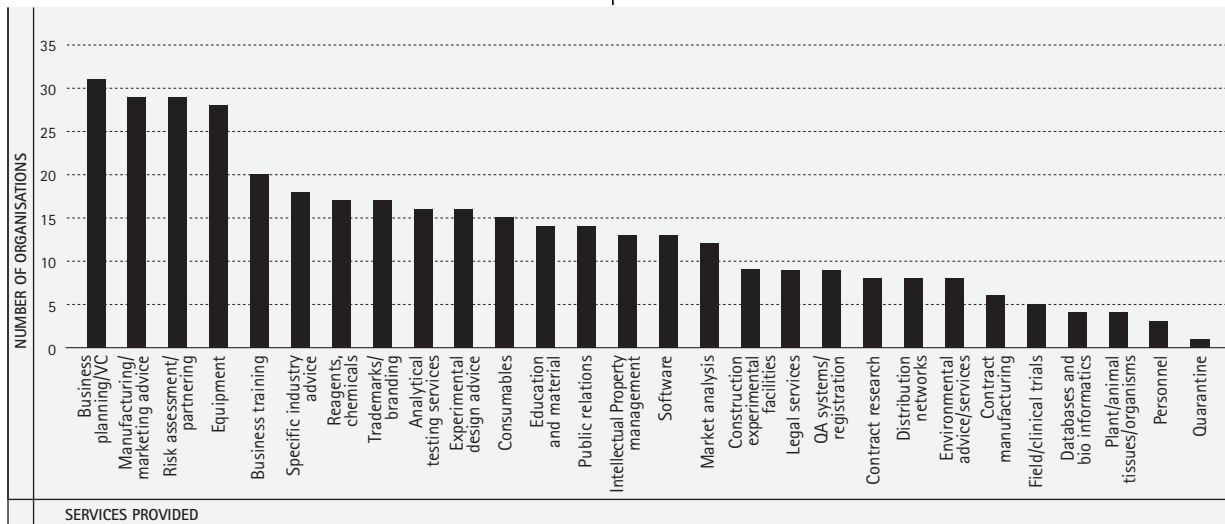
Table 16 The number of staff with tertiary qualifications required in five years is predicted to increase by over 100%

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	83	24	70	154
Master's degree	92	53	121	213
Bachelor's degree	204	66	195	399
Diploma/Certificate	60	27	78	137
Total	439	170	464	903

Organisations were asked to indicate from a list which products and services they provide to biotechnology organisations.

7.4 Capabilities

Figure 91 More Suppliers provide general products and services than biotechnology-specific products and services



7.5 Development of new products and services

Thirty six of the 98 respondents (37%) report that they are developing new products and services for the biotechnology industry.

Twenty four of the 36 expect their new products and services to be ready for release in less than two years, 10 expect to be ready in two to five years. The other two did not indicate a time frame for product and service development.

8 Overview and Comments from Industry Members

This section looks at some of the overlap between categories of organisations as outlined in Section 2, and considers a few industry-wide parameters across all those organisations that responded to the questionnaires. It also summarises the comments provided by 177 respondents on the needs of the industry.

Note that the number of comments reported in each part of this section is not necessarily an indication of the proportion of respondents who hold opinions on a particular subject.

8.1 Organisation background and relationships

Respondents were asked to select from a list those descriptions that most applied to them. A number of Suppliers carry out research and see themselves partly as Core Biotechnology organisations, while a number of biotechnology organisations make and sell products to other biotechnology organisations, and see themselves partly as Suppliers.

Table 17 There is considerable overlap between the general category of biotechnology organisation and that of Supplier

DESCRIPTION	NO. OF ORGANISATIONS SELECTING DESCRIPTION		
	BIOTECH	SUPPLIER	TOTAL
Core Biotechnology organisation carrying out scientific research and development.	46	12	58
Biotechnology organisation selling products or services based on New Zealand-owned intellectual property.	54	13	67
Biotechnology organisation selling products or services based on overseas-owned intellectual property.	11	9	20
Natural Products organisation.	38	2	40
Supplier of goods or services to other biotechnology organisations.	20	74	94

8.1.1 Joint projects and collaborations

There were a number of comments from respondents on the need for collaborations and joint projects. Despite the high number of collaborations reported, many respondents feel that there is considerable room for improvement.

Twenty three of the 200 total respondents commented on the need for collaborations amongst universities, CRIs and private organisations.

Representative comments were:

- 1 "For university-based research groups, communication with industry would help us to direct efforts towards the production of commercial products."
- 2 "Better cooperation between CRIs and industry. Costs to industry of collaboration with CRIs are very high."

- 3 "Need active applied science research, 50% facilitated by industry."
- 4 "Management of R&D effort amongst CRIs and universities to avoid fragmentation and duplication of effort and investment in facilities."
- 5 "Considerable expertise and skills are available in New Zealand, particularly in CRIs and universities. But companies seem unaware of it!! And so we don't use it."
- 6 "Provide increased incentives for universities and private partners to collaborate and form seamless pipelines from discovery to technology transfer."

8 Overview and Comments from Industry Members

- 7 "Facilitate relationship development between business and CRIs/universities. Know + like + trust = relationship; these three things are key to building business. This should be done across a number of levels on both the business side and the CRI/university side. Identify stakeholder groups on both sides that are relevant to commercialisation of biotech and focus on interactions that build relationships (e.g. students, junior staff, senior staff, and departments for universities)."
- 8 "Somehow the competitive aspect of research funding needs to be modified. At present, cooperation between researchers in different CRIs or other research groups is muted by concerns about funding. Publishing is no longer as important as protecting commercial options. This is understandable, but hinders progress on the national scale."

Thirty seven of the 200 noted the need for general co-operation and sharing of resources within the industry.

Some representative comments:

- 1 "New Zealand needs to raise its profile in the R&D marketplace and more businesses should accept the role of being the service provider to other institutions to fund core activities and some specialist research."
- 2 "The entire industry and research effort is unco-ordinated and disjointed. New 'players' enter the field completely unaware of what already exists."
- 3 "Better, genuine collaborations, especially in specialist areas. The major players seem reluctant to use out-sourced expertise. To a degree, some large players have unnecessary fears about IP security: New Zealand is simply too small to have local companies genuinely competing. A consequence is that some potential collaborators, especially small players like myself, are sometimes treated as competitors. IP issues are tricky, but in my opinion only very large companies can honestly attempt to do everything in-house; collaborations are necessary."

- 4 "We need bridging between R&D labs and manufacturing companies."
- 5 "New Zealand companies outsourcing rather than duplicating in-house capability and infrastructure – they lack critical mass, expertise and supporting infrastructure to be internationally competitive."
- 6 "Co-ordinate all our biotechnology output to prevent competition for internal and external funding and optimise the use of our limited resources such as IP management, IT, drug development, etc."
- 7 "Proactive collegial organisations to strengthen New Zealand collaborations."
- 8 "A directory of product and service providers, contacts indicating what services and products they provide along with some background on them would be beneficial to allow our industry to work together."
- 9 "Understand that New Zealand can only compete globally as ONE UNIT (i.e. 4 million people) and not as many centres (Wellington, Hamilton, Auckland, etc.)."
- 10 "What is lacking is support for the infrastructure of research – DNA sequencing, real-time PCR, genomics, bioinformatics, proteomics analysis and servicing. It is wasteful to have each group come up to speed on these types of technology and equipment – especially the need to overcome the initial inertia."
- 11 "The industry is not working to maximise use of facilities, minimise importation of expensive equipment that may not be used to any more than 60% capacity."
- 12 "Co-ordination of the industry, enhanced co-operative industry marketing activity."
- 13 "Businesses should be grouping together to reduce cost structures (particularly back office functions) and to make themselves more attractive to serious local and overseas investors. In so doing they leave themselves less exposed to individual technology failures. Too many small players are working on their own. They need to better support each other and work collaboratively. Together as a group they may be more successful in obtaining the funding they need."

8.1.2 Research and Intellectual Property

Table 18 Some Supplier organisations carry out research, file patents and publish papers

	BIOTECHNOLOGY ORGANISATIONS	SUPPLIER ORGANISATIONS	INDUSTRY TOTAL
Engaged in research	82	28	110
Has applied for patents	61	11	72
Biotechnology-related publications last 12 months	1,088	59	1,147

8.1.2.1 Biotechnology organisations and Intellectual Property

Sixty one biotechnology respondents have filed biotechnology-related patents, and 46 have had more than 760 patents granted in the last five years. Eleven Supplier organisations also applied for biotechnology-related patents, but were not asked for detailed information about these applications.

Biotechnology respondents reported a total of 882 patent applications filed but not yet granted, and total patent application and management costs of \$11.1 million in the last financial year.

Biotechnology respondents have had more than 760 patents granted in the last five years. Note that number of patents does not indicate number of inventions, as a single invention may be comprised of a number of different patents that are filed in more than one jurisdiction.

8.1.2.2 Contractual rights to use Intellectual Property

Of the 102 respondents who completed the biotechnology questionnaire, 49 (48%) reported acquiring rights to use Intellectual Property (IP) from other organisations in the previous 12 months.

8.1.2.3 Comments on Intellectual Property management

Fourteen of the 200 total respondents commented on the management of IP within the industry. Some of the comments were:

- 1 "We need greater education on strategic use of IP."
- 2 "Need good selection of IP for development."
- 3 "Develop more sophisticated methods for handling IP so that research providers and funders have more realistic expectations of outcomes from basic biotechnology-based research."
- 4 "We need a clearer New Zealand strategy based on potential for realising true commercial revenue from biotech based products. Government funding of R&D must be focused on selected areas of potential – these must be aligned to commercial reality – i.e. Government must listen to commercial companies."

- 5 "I personally worry if some of the companies have a real product in mind, or are more or less hoping something will emerge if they do research in their chosen area (eg. 'We will improve wool'). I think companies need to balance their internal portfolios with a few 'safe but more obvious' products."
- 6 "Very important to educate the innovators, the scientists in the lab, about commercial opportunities, encourage development of IP that could form the basis of an attractive business venture; too much mediocre IP currently generated, not worth much commercially."
- 7 "Support for university commercial groups (eg. Innovate Otago, Unilink, Uniservices) to enable them to aggressively identify science that can be commercialised."

There were also some comments on the way universities and CRIs handle intellectual property. For example:

- 1 "Need change in CRI direction to actively encourage spin-offs rather than seeking to protect their own revenues."
- 2 "Should have a 'use it or lose it' requirement placed on CRI and university IP."
- 3 "Government should give government-funded IP generators a clear directive as to commercialisation objectives for the organisation, and the CEO/Vice Chancellor of each organisation should then be a leader in spinning out technology. There are plenty of examples, see Cambridge University."

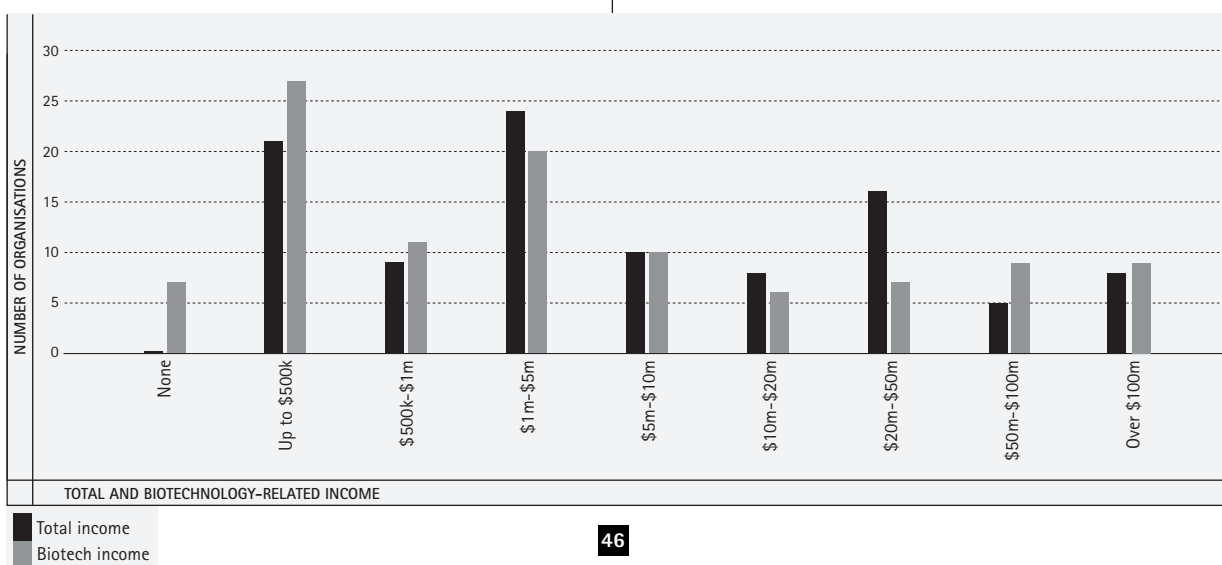
8.2 Financial

8.2.1 Industry income and expenses

8.2.1.1 Total and biotechnology-related income for biotechnology organisations

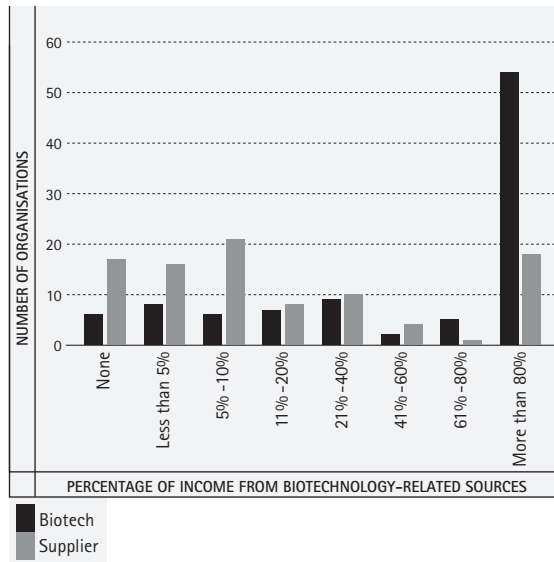
Respondents were asked to indicate a range for total and biotechnology-related income in the last financial year. Two biotechnology organisations declined to provide any information on biotechnology-related income and expenses.

Figure 92 Many of the 102 biotechnology respondents reported biotechnology-related incomes below \$5m, and some had biotechnology incomes of zero. There were more than 40 organisations with total income below \$500k



While many biotechnology organisations currently have low levels of biotechnology-related income, there are significant numbers of products expected to come to market over the next few years.

Figure 93 While many biotechnology organisations reported more than 80% of their income from biotechnology, biotechnology-related income is only a small percentage of total income for most Suppliers



8.2.2 Regulatory approval processes and costs

Many biotechnology organisations must obtain regulatory approval for processes, organisms and materials that they use in research, product development and manufacture of products. Costs associated with regulatory approval include fees from organisations such as the Environmental Risk Management Authority (ERMA), legal fees, and in-house costs of preparing approval documents. In the last financial year, the 102 biotechnology respondents report spending a total of \$14.57 million on biotechnology regulatory approval processes

Forty five of the 200 respondents commented on the cost, difficulty and capricious nature of the regulatory approval process.

Representative comments were:

- 1 "Need regulations and regulatory costs to become less restrictive."
- 2 "Reduce ERMA compliance costs."
- 3 "Reduce compliance costs (ERMA/courts/political process/anti-GE lobby)."
- 4 "ERMA – common sense must prevail eventually!"
- 5 "Better communication with and understanding by regulatory bodies."
- 6 "Streamline regulatory procedures, we are knee-capped by current law."
- 7 "Streamline and rationalise the regulatory environment to ensure agencies are focused on true hazards and not politically-driven issues."

- 8 "Regulatory and compliance culture at government (including at local authority level) is restrictive and inflexible. Need culture change from ministerial level down."
- 9 "Pharmac has to go or at least to be profoundly changed, HASNO needs to be overhauled, ERMA needs to disappear. It is difficult to have a healthy biotech industry future with current legislation and regulation."
- 10 "New Zealand government to introduce/amend regulatory framework covering R&D and investment to mirror that of Australia."
- 11 "A large amount of the big pharmaceutical companies have already claimed that Government policy on subsidising medicines makes it difficult for drug companies to be in New Zealand. That for a start should change because foreign investors and overseas pharmaceutical companies bring with them not only jobs, but education, innovation, cutting edge of science in regards to training for young New Zealand scientists and entrepreneurs."
- 12 "The Government MUST create a globally competitive and attractive legal, regulatory and tax environment capable of attracting and sustaining the long-term investments required to succeed in the world stage of biotech business. At present this is NOT the case. The regulatory and statutory framework is NOT conducive to attracting business to invest in biotech in New Zealand. Frankly, it is complex, bureaucratic, very costly and time-consuming, and subject to influence or changes at the whim of various extremist lobby interests. Once obtained, approvals are time-limited, and there is no guarantee that there will be a positive outcome in terms of an extension or continuation once the time-frame is complete. There is no certainty of continuation! And there is the whole process and cost of 're-applying' to go through. Try explaining that to a US biotech company and see if they would like to consider investing in our 'cheap labour' environment."

8.2.3 Capital expenditure

The 102 biotechnology respondents report spending:

- \$35.05 million on equipment capital expenditure.
- \$21.33 million on specialised facilities for research, production, quality control processes over the last financial year.

8.2.4 Export earnings

Total export income reported by the 200 biotechnology and Supplier respondents in the last financial year was around \$233 million. Approximately \$30 million of this came from the 98 Supplier organisations.

Several organisations reported export income as a range rather than a number. The actual export income reported by respondents lies between \$224 million and \$251 million.

8.2.5 Investment funding

Biotechnology organisations were asked whether they had obtained investment funds in the last financial year, and from whom. Of the 102 respondents, 32 indicated that they had obtained investment funding.

Fifty nine respondents indicated that they intended to seek investment funds in the near future.

- 33 within 12 months.
- 22 within 2-3 years.
- 4 within 4-5 years.

8.2.5.1 Comments on investment funding and assistance required

There were many comments from respondents on the need for government and venture capital funding, also on the difficulties of obtaining funding in an industry with long product development times and high risk.

- 86 of the 200 respondents said that some form of government assistance is required.
- Eight said there was a need for increased investment in research.
- 17 pointed out that there is a need for investment in commercialisation, not just in research and development.
- 19 mentioned tax reforms that would encourage local private investment in research and development.
- Nine said that tax reforms were important for attracting overseas investment in the industry.

8.2.5.2 Comments: need for government support

- 1 "Increase the government funding available to start-up companies, introduce tax incentives for start-ups."
- 2 "Substantial investment in the university-based training of skilled graduate students providing greater funding opportunities for university-based lecturers and researchers."
- 3 "More government support and regional support. Current programmes are too small and too complicated. The government needs to put some serious resource into fostering R&D and export programmes. Current resources deployed are a joke, compared to other areas of government spending. Suggest something broad like 120% recovery of R&D and export development expenditure."
- 4 "There are critical capital-requiring phases along the value chain to market in commercialising a product. New Zealand through government offers some support to these critical phases, eg. Industry New Zealand. In comparison with our neighbours (eg. Australia) this is woefully inadequate. I would like to see government initiatives encouraging capital investors to 'take a punt' at encouraging biotech growth in New Zealand."

- 5 "A small amount of government-funded assistance to help compliance with New Zealand and overseas regulations would reduce barriers to trade which can inhibit export business."
- 6 "To help small enterprises continue to develop new products and services within this industry, funding needs to be easily accessible and not create extra work through 'red tape.'"
- 7 "Put in place structures that give confidence to the industry that there will be support in the long term (more than 10 years)."
- 8 "Government and FRST funding needs to be managed by industry. Government workers seldom understand what is required in the market (and by scientists), and place unrealistic targets or impose cumbersome reporting/application processes on funding applicants."
- 9 "Government funding is too fragmented – it is impossible to develop any biotech product on less than \$1m even at the discovery phase."
- 10 "New products need ease of access to the domestic market to establish their sales potential and enhance their attractiveness to overseas distributors. To facilitate this we need a thorough 'fast track' product registration process that will have international credibility. Then we need domestic market promotional assistance i.e. Government grants for subsidised advertising on radio and TV, also assistance with PR."
- 11 "Great and managed government intervention and workforce planning through promotion of science and technology careers, especially process engineering and technology degree programmes, with adequate funding of ALL university science programmes."
- 12 "Current innovation strategies, TechNZ and PGSF funding are very positive steps, but \$\$ will need to be increased to achieve real potential."
- 13 "Increase funding for basic research/discovery – grants need to be larger and of longer duration to provide continuity and reduce downtime due to multiple grant writing."
- 14 "Government financial support for technology transfer activities in universities (it should not be subsidised by Vote Education)."
- 15 "Clear indications of the Government direction on GE."
- 16 "Government needs to support independent market and product development services, not compete with them as Trade New Zealand has done."
- 17 "Special incentives and support should be offered by the government with regards to New Zealand-owned companies in the biotech industry."

- 18 "We need a business and research climate which encourages long term strategic research and the forging of links between research institutions and industry. This long term strategy should be so developed to encourage commitment by overseas biotech organisations to investment and research in New Zealand, especially of a type that uses inputs that are based on our ability to produce raw materials that can be used for the production of biotech products. At the same time, local companies must also be offered incentives to invest in long-term research and to form partnerships with university/CRI/research organisations. Companies need to be certain that there is certainty and stability in Government policies."
- 19 "More government officials with a better understanding of science and business to provide the right kind of leadership for the industry."
- 20 "There is very limited private equity available for projects of this nature. A greater level of investment incentives will be required to attract private equity. I am not aware of any venture capital funds based in New Zealand focusing on biotech. Greater government funding (eg. 2:1) or tax incentives will be required."
- 21 "Incubation funding and support needs to focus on 'best bet' centres of excellence/biotech research, providing a sensible and sustainable 'proof of concept' fund as well as supporting the operation of incubators at those few locations. Get real and concentrate resources for results, as opposed to dissipating them across too many areas."

8.2.5.3 Comments: need for private investment

Twenty eight respondents commented on the need for and difficulty in obtaining venture capital funds, and the need for assistance with commercialisation of products. Some feel that there is a need for government assistance to encourage private investment.

- 1 "Needs to be more injection of money from private and government sources – some form of taxation subsidy for venture capital from private agencies."
- 2 "Encourage venture capital funding for the discovery rather than marketing of biotechnology."
- 3 "Some "venture capital/product development" organisation that can be approached or brought in as a partner for the scientist with a good idea or potential novel product under development. I have had a number of potential products which I have been unable to bring to market as I do not have the development, marketing or financial experience. If there was an organisation which specialises in this role, it would be invaluable."
- 4 "We need a higher level of venture capital available."
- 5 "We perceive the greatest difficulty facing the biotechnology industry in New Zealand is the ability to take ideas and IP developed in the laboratory to a commercial product. There needs to be greater access to venture capital and also training for skills required to set up start-up companies, gain IP protection, market approvals etc."

- 6 "We need to develop our capital funds and learn how to access these."

8.2.5.4 Comments: making investment attractive

Some respondents indicated a need to improve the attractiveness of investments in biotechnology, through a more commercial approach to IP development.

- 1 "Business opportunities arising from biotech IP are generally NOT attractive to a venture capital investor, because potential product is no better than existing alternatives, markets are too small, and capital investment required is too much."
- 2 "Not much capital in New Zealand to invest in high risk biotech start-up businesses, especially for products requiring expensive FDA approval. Hard to attract overseas capital investment."
- 3 "Very important to educate the innovators, the scientists in the lab, about commercial opportunities, encourage development of IP that could form the basis of an attractive business venture; too much mediocre IP currently generated, not worth much commercially."
- 4 "IP producers need to develop IP that can make it to market through Australasian funders. Therefore, research emphasis should be on commercialising non-FDA products."

8.2.5.5 Comments: need for investor education

Twenty respondents said there is a need to educate investors on the long-term benefits of investing in biotechnology.

- 1 "Need to communicate to potential investors that 'biotech' is a medium/long-term investment. Currently there is a false expectation of an immediate return, which is only due to the hype/speculation caused by brokers looking for a percentage. This pressure is transferred to scientists/companies who are expected to 'launch a product' to keep investors happy."
- 2 "New Zealand needs to educate/overhaul its services and banking/investment base to develop a framework which understands the nature (long lead times) and lack of instant gratification fundamental to biotech business... and not promote and talk about one if this can't be done."
- 3 "Develop a confident and active venture capital environment."
- 4 "The private sector needs to also be educated on the risks, time-frames, and nature of science before they invest. One biotech failure in New Zealand will sour the investment market due to unrealistic expectations at present."
- 5 "We need a well-informed capital market. Current public companies being brought to the market are of very low quality. Most or all will fail or stagnate, which will cause the unsophisticated investment community to dump the entire sector. This is currently the Wild West (or South)."

6 "Realistic expectations from within the industry and government circle about the time and risk related to growing successful biotech companies – patience."

8.2.5.6 Comments: need for public education

Twenty eight respondents commented on the need for public education in and a more balanced view of biotechnology. Some representative comments were:

- 1 "The onus is on scientists and biotechnologists to convey to the public facts, minus liberal extrapolations of basic science and 'potential'. If this is left in the hands of parties/individuals interested only in the short term (more specifically their own short term), then New Zealand biotech will stagnate into second-rate companies pushing 'snake oil' and 'elixirs of youth!'"
- 2 "We need a more enlightened view of GMOs. Better understanding by public and politicians of GMO risk."
- 3 "The industry needs to clearly differentiate between GM products and non-GM products in order to increase the acceptability of the non-GM research and development streams, which likely have a wider market and acceptance world-wide. The public sees 'biotech' as 'GM' and clarification to the public and market is needed."

4 "More public and political acceptance and less power of small lobby groups."

5 "All New Zealanders must take rational and balanced perspectives on the relative risks and advantages."

6 "Dispel fear, myth and ignorant rhetoric in the public domain."

7 "Greater value placed on science through the media. Better knowledge of science by reporters, leading to better quality reporting of science."

8 "There needs to be a lot more public education. The public will not support the biotech industry until such time as they are happy they are aware of the risks and the benefits and are satisfied that sufficient controls are in place to mitigate the risks. Until such time as this happens the public will remain uncertain and fearful about biotechnology. As long as that attitude continues, institutional investors will view investment in the biotechnology sector as a publicity risk."

8.3 Staff

Overall, the 200 respondents report that there are approximately 4,000 people engaged in biotechnology-related activities. Around 470 of these are employed by Supplier organisations.

8.3.1 Future requirements for staff with tertiary qualifications

Many of the people employed in the industry hold tertiary qualifications, and respondents predict a substantial increase in the numbers of qualified staff required over the next two to five years.

Table 19 Over the next five years, the 200 respondents predict an increase of more than 60% in their requirements for staff with tertiary qualifications

QUALIFICATION	CURRENT	INCREASE IN NEXT 2 YEARS	INCREASE IN NEXT 5 YEARS	TOTAL NEEDED IN 5 YEARS
Doctorate	1,288	177	431	1,720
Master's degree	682	229	599	1,281
Bachelor's degree	1,290	400	789	2,079
Diploma/Certificate	349	156	314	662
Total	3,609	961	2,133	5,742

8.3.1.1 Comments: need for training and incentives

Twenty one of the 200 respondents commented on the need to train more science graduates and provide them with incentives to stay in the industry in New Zealand.

- 1 "It will be critically important over the next decade to foster some stability/security for the biotech workforce. We need to recruit and retain really talented people. This will be difficult; the rewards and the recognition are not provided by the sector and by the wider community."

- 2 "Provide certainty of employment for our good graduates when they have completed their overseas experience."
- 3 "We need better scientific career prospects."
- 4 "Extension of the apprenticeship scheme to include science technicians. Technicians can train in laboratories whilst attending technical institutes or universities, providing a fast track to becoming useful technicians. At present, graduates from these schools generally need training in practical application of their education for 6-12 months before becoming serious contributors."
- 5 "Encouraging PhD students and post-docs to return to New Zealand at the completion of their studies and to bring back the new skills they have obtained as well as the connections they have established. To do this there needs to be additional funding for new salaries (preferably not short-term contracts.)"

8.3.1.2 Comments: need for commercial skills

Thirty five of the 200 respondents commented on the need to teach and develop business and commercialisation skills.

- 1 "Exposure of national and international role models to science students to help graduates gain an understanding of the business of biotech before they graduate."
- 2 "More Proof of Concept (POC) management expertise – need courses. Most inventions fail at the POC stage, more management and education is needed."
- 3 "Access to skilled entrepreneurs and industry specialists to provide commercial strength to sound scientific innovation – preferably experienced New Zealand expatriates returning from abroad."
- 4 "We need R&D scientists with business skills."
- 5 "Universities should train scientists in innovation and entrepreneurship."
- 6 "Support and analysis of the people as much as the IP – focus on how to run your business as much as how to protect your IP (IP without profitable sales is worthless)."
- 7 "The industry needs to encourage the development of skills at home. We have numerous people with the necessary skills to establish the industry in New Zealand, but they need to be mentored in order to develop skills to a level necessary for the industry."

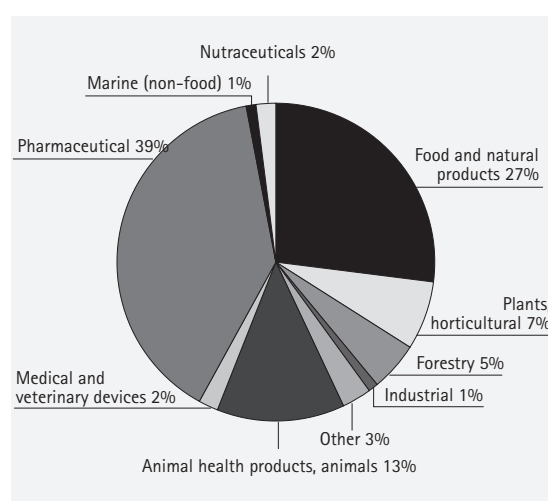
8.4 Products

8.4.1 Products on the market

This section of the questionnaire was not completed by all respondents because of concerns about commercial sensitivity. Five respondents specified product types but did not indicate product numbers. Seventeen respondents had indicated that they expected to bring products to market over the next few years, but did not provide any data on the types of products under development.

Data on products were provided by 69 respondents, who reported 2,353 products on the market and another 589 under development.

Figure 94 *Pharmaceutical, animal health and food/natural products make up 79% of the biotechnology products reported on the market*



The "Other" product category includes cosmetics and chemical products.

8.4.2 Comments on products and sectors

Twenty five of the 200 respondents had comments about the focus of the industry and the best direction to take in product development.

Representative comments were:

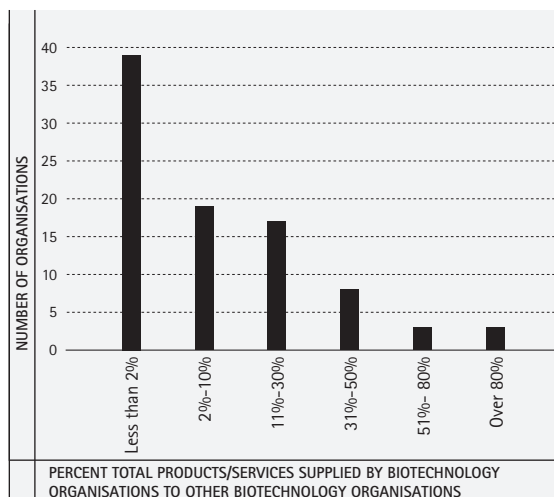
1. "Pick the winners and fund them very well. Provide funding and support to niche products or services. Do not compete against major global companies but find the niche markets/products/services."
2. "Lack of focus across the country. Too many clusters, too many projects, and continuing medical/agbio debate continues with activity in both areas."
3. "More emphasis upon plant biotechnology including plant tissue culture and plant biochemistry research; plants as a natural resource have been undervalued in terms of their deployment for cleaning up pollution, providing health benefits."

4. "Focus on New Zealand's niche areas and areas of importance to New Zealand industries. Appreciate that all countries are trying to improve their economic base through biotechnology, and therefore we have to focus on what we do best."
5. "Exploit the genetically-diverse pool of domesticated ruminants to produce new 'Pharm' animals. Utilise the special disease-free status of our livestock to produce new pharmaceuticals and enhanced foods."
6. "More support in the nutraceuticals/biologics/bioactives area, with a food/additives/supplement focus, and less emphasis on pharmaceuticals where New Zealand cannot compete with the multibillion dollar investment of major drug companies."
7. "Focus on our core strength, rather than on trying to be a 'biotechnology centre of excellence'. We should aim to be an agbiotech centre, or more specific centre that builds on existing strengths. Other countries have too much capability and investment resource for New Zealand to compete on the broader definition of biotech."
8. "Focus on New Zealand's areas of expertise and traditional skills e.g. in agriculture, dairy etc. This includes exploiting our natural advantages e.g. lack of animal diseases, good natural resources, 'green' image; presenting offshore companies with opportunities for diversification and thus spread of risk."
9. "New Zealand needs to develop specific areas of expertise and recognition that are internationally unique. It is much harder if New Zealand is competing internationally with other organisations. We need to identify areas where we can be highly successful. We should not become a 'me too' biotechnology industry."

8.4.3 Biotechnology organisations as suppliers

Many biotechnology organisations also act as suppliers to other biotechnology organisations.

Figure 95 Of the 102 biotechnology respondents, 54 supply more than 2% of their products or services to other biotechnology organisations



9 Responses to the Survey

A very high response rate was obtained to the survey, especially from Core Biotechnology organisations. The questionnaires were complex, and respondents generally appeared to have taken care to read the questions carefully. The industry is to be congratulated on the overall quality of the responses.

A few organisations declined to provide part or all of the financial data requested, and some did not provide data on products under development.

Table 20 Organisation numbers and response rates

	RESEARCH	CORE BIOTECH	OTHER BIOTECH	NATURAL PRODUCT	SUPPLIERS	TOTAL
Number of organisations responding	19 ¹	39	18	26	98	200
Total number of organisations surveyed	19	42	26 ²	43	128	258 ³
% responding to Survey		93%	69%	60%	77%	78%

Notes to Table

- ¹ The 19 Research organisations include six universities. Responses have been received from 51 departments across these universities (73% of those surveyed) and consolidated as much as possible. Data from the universities are not complete.
- ² Includes Medical Device, Product Biotechnology and Pharmaceutical organisations.
- ³ Several organisations have provided one response for a group of related companies.

In some cases, a single response has been sent in from an organisation with several different divisions and subsidiary companies.

Multinational pharmaceutical companies that do not have significant research or production facilities in New Zealand were not included in the survey.

The survey questionnaires included a general question asking for comments on industry needs, and many respondents gave thoughtful and frank responses to this question. Of the 200 respondents, 177 provided comments on the problems and opportunities confronting the industry.

10 Summary data from respondents to the Survey

Data were received on 210 of the 268 organisations surveyed. Ten of the Other Biotechnology organisations were included in joint returns with sister or parent organisations, and the final total number of respondents was 200.

Summary data are reported in this section for the two groups of organisations who responded to the two types of questionnaire used in the survey: 102 biotechnology and 98 Supplier respondents. The biotechnology group includes Research, Core Biotechnology, Other Biotechnology and Natural Products organisations. See Section 11 for definitions of the organisation groups.

Some quite large organisations did not respond to the survey, and their data on income, export earnings and staff numbers may have made a significant difference to total numbers. The summary data in this section should be interpreted with caution.

Detailed data from the various categories of organisation are provided in Sections 3 to 8.

10.1.1 Research

- 1 Of the 200 respondents, 110 are engaged in some kind of research. Twenty eight of the 110 engaged in research are Supplier organisations.
- 2 The industry has published more than 1,100 biotechnology-related articles in refereed publications in the last 12 months.

10.1.2 Intellectual Property

Biotechnology respondents were asked to provide detailed information on Intellectual Property (IP), while Suppliers were simply asked whether they had ever applied for biotechnology-related patents.

- 1 A total of 72 of the 200 respondents (36%) have applied for patents at some time. Eleven of these are Supplier organisations.
- 2 Within the last five years, biotechnology respondents have been granted more than 760 patents, over 120 of these outside New Zealand. (Number of patents does not indicate number of inventions.)
- 3 More than 880 patents have been filed by biotechnology respondents but are not yet granted.
- 4 Patent applications and management of IP cost biotechnology respondents \$11.1 million in the last financial year.
- 5 Around 50 biotechnology respondents contracted the use of IP from other biotechnology organisations, both within New Zealand and overseas.
- 6 Fourteen of the 200 respondents commented on possible ways to improve industry management of IP.
- 7 Six respondents indicated a need to improve the attractiveness of investments in biotechnology, through a more commercial approach to IP development.

10.1.3 Partnerships

- 1 Eighty five biotechnology respondents reported joint projects and collaborations with other organisations in the last 12 months. These collaborations involved more than 860 separate joint projects or collaborations with different organisations, half of them outside New Zealand.
- 2 Thirty seven of the total 200 respondents noted the need for general co-operation and sharing of resources within the industry.
- 3 Twenty three commented on the need for collaborations amongst universities, CRIs and private respondents.

Supplier organisations were not asked to provide details of partnerships.

10.1.4 Financial

- 1 Many of the total 200 respondents reported biotechnology-related incomes below \$5m, and some had biotechnology incomes of zero. There were more than 40 organisations with total income below \$500k.
- 2 Many biotechnology organisations reported more than 80% of their income from biotechnology, but biotechnology-related income is only a small percent of total income for most Suppliers.
- 3 In the last financial year, biotechnology organisations reported expenditure of:
 - \$14.53 million on biotechnology regulatory approval processes.
 - \$35.05 million on equipment capital expenditure.
 - \$21.31 million on specialised facilities for research, production, quality control processes.
- 4 Respondents (biotechnology and Supplier) report total export income between \$224 million and \$251 million.
- 5 Around 30 biotechnology organisations obtained investment capital in the last financial year, most from New Zealand investors. More than 50 indicated that they will seek further investment capital in the next three years.
- 6 Eighty six of the total 200 respondents said that some form of government assistance is required.
- 7 Forty five commented on the cost, difficulty and capricious nature of the regulatory approval process.
- 8 Twenty eight commented on the need to educate the public of New Zealand in science and risk/benefit analysis in biotechnology.

10 Summary Data from Respondents to the Survey

- 9 Twenty eight respondents commented on the need for and difficulty in obtaining venture capital funds. Some feel that there is a need for government assistance to encourage private investment.
- 10 Nineteen mentioned tax reforms that would encourage local private investment in research and development.
- 11 Twenty said that there is a need to educate investors on the long-term benefits of investing in biotechnology.
- 12 Seventeen pointed out that there is a need for investment in commercialisation, not just in research and development.
- 13 Nineteen said that tax reforms were important for attracting overseas investment in the industry.
- 14 Eight said that there was a need for increased investment in research.

10.1.5 Staff

- 1 The 200 respondents employ around 4,000 staff in biotechnology-related activities, around 12% employed by Suppliers. However, data from universities is incomplete and staff numbers may be significantly higher. Research organisations (including universities) report employment of 1,850 staff in biotechnology.
- 2 Over 3,600 of biotechnology staff have tertiary qualifications. Demand for about another 2,100 people with tertiary qualifications is expected by the industry over the next five years.
- 3 Thirty five of the total 200 respondents commented on the need to teach and develop business and commercialisation skills.
- 4 Twenty one commented on the need to train more science graduates and provide them with incentives to stay in the industry in New Zealand.

10.1.6 Products

Information on product number and type was collected from biotechnology organisations, not from Suppliers.

- 1 Seventeen of the 102 biotechnology respondents did not provide any data on product numbers and types.
- 2 Of the other 85 biotechnology respondents, 69 report that they have products on the market. More than 2,300 products are reported as currently on the market, and around 600 under development.
- 3 Pharmaceutical, animal health and food/natural products make up 79% of the products reported on the market. A similar mix of products is reported to be under development.
- 4 Over 50 biotechnology organisations supply a significant percentage of their products or services to other biotechnology organisations.
- 5 Of the total 200, 25 respondents had comments about the focus of the industry and the best direction to take in product development.

11 Definitions and Background Information

11.1 Definition of biotechnology

Biotechnology is defined in many dictionaries as follows:

"The application of science and engineering to the direct or indirect use of living organisms, or parts or products of living organisms, in their natural or modified forms."

This is a very broad definition, which could include products such as meat, wool, milk, vegetables, fish, and wood.

If we consider biotechnology as a separate industry, as many OECD countries are now doing, a narrower definition is required. Products such as milk and wood are included in specific industry classifications like Dairy and Timber, and industrial definitions of biotechnology tend to focus more on the research and development required to develop novel products and services. The definition used by government departments in New Zealand (such as New Zealand Trade and Enterprise) over the past few years is as follows:

"Biotechnology is the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof and molecular analogues for products and services."

This definition was included in the survey questionnaires.

A simpler definition that may be more appropriate for future use is:

"A range of activities which primarily uses the knowledge of how cells work, and their mechanisms to produce and fix things."

11.2 Categorisation of organisations for data analysis

Organisations have been divided into five main categories for data analysis:

- 1 Research.
- 2 Core Biotechnology.
- 3 Other Biotechnology.
- 4 Natural Products.
- 5 Suppliers.

The Other Biotechnology category includes three sub-categories: Product Biotechnology, Medical Device and Pharmaceutical organisations. Numbers of organisations in these sub-categories are too small for confidentiality to be maintained if their data were to be presented separately.

Where there is overlap between categories, each organisation is categorised according to its main activities. For example, Core Biotechnology organisations that are developing medical devices remain in the Core Biotechnology group, not in Product Biotechnology along with Medical Device organisations.

Table 21 Categories used in the biotechnology Capability Survey

CATEGORY	SUB-CATEGORY	DESCRIPTION
Research	Biotechnology	Carrying out research, development and IP commercialisation in NZ.
Core Biotechnology		Carrying out research, development and IP commercialisation in NZ.
Other Biotechnology	Product Biotechnology	Producing biotechnology products and/or services in NZ, some product development but no primary research
	Medical Devices	Developing medical device products in NZ. Most (but not all) of these organisations are also Core Biotechnology organisations.
	Pharmaceutical	Developing, testing or manufacturing pharmaceutical products in NZ.
Natural Products		Applying technology to the development and production of Natural Products in NZ.
Suppliers		Providing goods and services to the biotechnology industry in NZ.

11.3 Biotechnology value chain

Biotechnology organisations carry out research and develop novel products based on the function of plant or animal tissues and/or genetic material. Most product development moves through a fairly standard sequence of processes, which collectively are called the biotechnology value chain.



In the Capability Survey, resource allocation and listing of organisational capabilities have been considered in terms of this biotechnology value chain.

Table 22 *Biotechnology value chain stages defined*

STAGE	DESCRIPTION
The idea	Research ideas can be market-driven or technology-driven, and can come from: a) university/CRI/research organisation in the course of scientific endeavour; or b) a commercial entity in the course of research or day to day business. This commercial entity could be any type of company from a large corporation to a one-man-band, an entrepreneur to a more traditional type of company.
Research	Primary research designed to test an idea and identify potential products. Research may be focused on specific molecular properties, or may involve high-volume functional "screening" of a range of molecules.
Proof of principle	Applied research designed to test the likely efficacy of potential products discovered or identified in the primary research stage.
Partnering, trials, testing	Wider testing of potential products which appear to function as predicted. This stage generally requires large volume animal or plant testing, and adequate funding of trials that might take months or years to run. Many Research organisations form partnerships with larger companies at this stage, and exchange a percentage of future profits for the funds necessary to test promising products.
Market approval	Many biotechnology-based products must demonstrate their safety and efficacy before they can be marketed. The length and complexity of market approval testing varies from simple approval processes through to four-stage clinical trials required for pharmaceutical products. Organisations often form new/extended partnerships at this stage, and again exchange a percentage of future profits for the resources necessary for market approval.
Product market entry	Identification of target markets, setting up manufacturing and packaging facilities and processes, establishing product distribution chains, marketing, routine production operations.

Some of the organisations that make up the biotechnology industry in New Zealand are operating at the research and development end of the value chain, some are focused on the production and sales end, and some operate across most of the value chain. Over time, the spread of organisations along the value chain may change.

11.4 Product sectors

Biotechnology products are sold across a range of different sectors. The sectors used in the survey are defined below.

Table 23 Ten biotechnology product sectors

SECTOR	DESCRIPTION
Animals/animal health products	Animals with specific characteristics, animal health products.
Plants	Horticultural (non-food) products, plants with specific characteristics.
Medical and veterinary devices	Implants, drug delivery devices.
Marine	Non-food marine products.
Pharmaceutical	Health products, pharmaceuticals, drugs that require licensing before they can be marketed. Excludes nutraceuticals.
Nutraceuticals	Food products that provide specific medical or health benefits, including the prevention and treatment of disease.
Food and natural products	Dietary supplements, food additives, herbs and natural products.
Forestry	Concerning the production of trees for timber or pulp products.
Industrial	Products or processes used for industrial applications.
Environmental	Concerning environmental impact assessment and clean-up of contaminants.

The time needed to develop a product from the original idea for a potential product through to market entry may be three-to-five years for nutraceutical or horticultural products, and seven-to-ten years for pharmaceutical products. Many good ideas never result in viable products, and potential products can fail at any stage in the process. biotechnology organisations usually aim to have a range of potential products at various stages of development, in order to minimise overall product development risk and smooth out future income; this portfolio of different products is referred to as a product pipeline.

11.5 Groups of supplier organisations

In any industry cluster there are organisations which supply vital materials and services to the key organisations within the cluster. These supply organisations often service a range of other industry sectors as well.

The biotechnology industry is no exception. There are several groups of suppliers to the industry:

- Suppliers which are biotechnology companies themselves, and provide reagents, research facilities, manufacturing facilities, consulting, or other goods and services to a range of biotechnology companies. For example, some Research organisations provide contract research facilities, and some biotechnology product manufacturers provide contract manufacturing and packing services.

- Suppliers which are not biotechnology companies but provide essential goods and/or services to biotechnology companies and specialise in the biotechnology industry; for example, developers and providers of specialised software.
- Suppliers which provide goods and/or services to several different industries, and for which the biotechnology provides an important but not exclusive source of customers; e.g. suppliers of scientific equipment, legal firms that provide patent expertise.

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