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Overview of the Biotechnology Use and Development Survey - 2003

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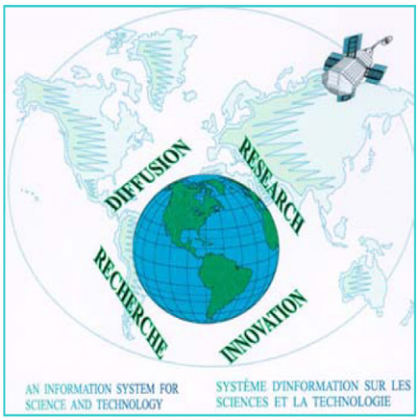

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Working Papers

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Symbol legend

These symbols apply to all the tables in this document; they are used in Statistics Canada publications. Data in these tables result from the 2003 Biotechnology use and development survey; they are preliminary and can be subject to revision.

.	not available for any reference period
..	not available for a specific reference period
…	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the Statistics Act
^{E}	use with caution
F	too unreliable to be published

NOTE: Due to rounding, components may not add to totals

The science and innovation information program

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors**: are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities**: include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages**: are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes**: are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts**: are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998 (Cat. No. 88-204)** first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a Statistical Information System,** Cat. No. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. No. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193.

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Highlights

- There were 490 biotechnology innovative firms in Canada in 2003, a net increase of 115 companies from 2001.

- Almost three-quarters of the biotechnology firms in 2003 are small firms, more than half are in the Human Health sector (53%) and 70% are located in Quebec, Ontario and British Columbia.

More firms declared revenues

- Of the 490 biotechnology innovative firms, 308 declared some biotechnology revenues (a 7% increase compared with 2001) and 389 declared revenues in 2003.

- In 2003, nearly half (47%) of the firms that declared biotechnology revenues are in the Human Health sector.

- Biotechnology innovative firms generated $3.8 billion in 2003 in biotechnology revenues, a 7% increase compared to 2001.

- Biotechnology revenues in the Human Health sector saw a 19% decrease between 2001 and 2003. Despite this decrease, firms in this sector contributed to more than half of Canadian biotechnology revenues in 2003. This trend was maintained throughout the 1997 to 2003 period.

- In the Agriculture sector, biotechnology revenues grew by 93% between 2001 and 2003. In fact, the number of products in production or on the market for this sector more than doubled between 2001 and 2003.

- Large firms that represented 13% of the 490 firms in 2003 generated 64% of biotechnology revenues.

R&D spending tripled since 1997

- Biotechnology R&D expenses tripled between 1997 and 2003 going from $494 million in 1997 to $1.5 billion in 2003.

- In 2003, medium-sized firms contributed to the majority of biotechnology R&D, followed by small firms.

- In 2003, firms in the Human Health sector contributed to 89% of biotechnology R&D. They are followed by firms in the Agriculture sector who represent only 4% of biotechnology R&D.

- Firms in Ontario and Quebec spent the largest share of biotechnology R&D in 2003.

Raising capital: a 73% increase since 2001

- Canadian biotechnology firms raised $1.7 billion in capital in 2003 for biotechnology activities, a 73% increase from 2001.

- Of the 490 biotechnology firms, 254 attempted to raise capital and 178 were successful. Also, around 53% of those firms that were successful in raising capital in 2003 met their target compared to 56% in 2001.

- Firms in the Human Health sector raised 86% of all capital for biotechnology activities in 2003, followed by firms in the Agriculture sector (8%).

- Small firms raised the most capital for biotechnology in 2003 (41%) compared to other size categories. However, only 49% of small firms reached their target in 2003, compared to 69% of medium-sized firms and 70% of large firms.

- In 2003, private placements were the main source of capital for biotechnology innovative firms (29%) followed by Canadian-based venture capital (14%).

- In 2003, Canada had 11,863 employees with biotechnology-related activities representing 16% of total employment of Canadian biotechnology innovative companies.

- In 2003, Canadian biotechnology innovative firms had 17,065 products/processes in development and on the market. Almost 65% of this number consists of products on the market mainly in the Human Health sector.

Introduction

Between 1997 and 2003, the number of innovative biotechnology firms rose from 282 to 490. Biotechnology in Canada continued to expand between 2001 and 2003, generating revenues of almost $4 billion. Biotechnology companies have more than quadrupled their revenues since 1997, making biotechnology a fast growing activity. The number of biotech products on the market has risen from a level of 1,758 in 1997 to a little more than 17,000 in 2003. For each dollar invested in biotechnology R&D, firms generated $2.57 in biotech revenue, compared to $1.65 in 1997, $2.36 in 1999 and $2.67 in 2001. However, to support this growth, the firms needed additional capital. In 2003, innovative biotechnology firms raised more than $1.7 billion in capital, an increase of 73% over 2001 and more than 200% more than in 1997. The year 1999 was an exceptional year with $2.2 billion capital raised. In 2003, among the firms that raised new capital almost 53% reached their target; in 2001 56% did so. Small firms, however, continue to face difficulties in raising capital. In 2003, of the 139 small firms that said they succeeded in raising capital, nearly 49% said they reached their target. That compares with a rate of 69% for medium-size firms and 70% for large firms.

The 2003 Biotechnology Use and Development Survey is the fifth in a series of surveys conducted by Statistics Canada and its partners aimed at gathering data on the activities of Canadian innovative biotechnology firms. The survey was conducted as part of a project to develop biotechnology statistics under the Canadian Biotechnology Strategy. It targets firms that use and develop biotechnology in Canada in 2003. The survey asked the question: What are the characteristics and activities of firms that use or develop biotechnology as an important part of their activities? Data are provided on the firms' revenues, research and development activities, imports and exports, human resources, business strategy, intellectual property issues and on the use and development of biotechnology.

The population studied in this document is *biotechnology innovative firms*. They are also referred to in the document as biotechnology companies. These are firms that use biotechnology to develop new products or processes[1]. Biotechnology is defined using both a single definition as well as a list-based definition (OECD, 2005). Because the

1. The Biotechnology Use and Development Survey (BUDS) is a study of the use of a technology in which innovation occurs at the level of the process of creation. Innovation Surveys (IS) are generally based on the definition of innovation contained in the OECD/Eurostat Oslo Manual. BUDS differs from the Oslo Manual in three respects: i) the reference period: in the Oslo manual, a new product is a product that has been introduced into the market during the previous three years; BUDS instead uses the current period; ii) In an IS, innovation implies that a product has been introduced into the market. In BUDS, an innovative firm has products in development that are not necessarily on the market; iii) An innovative biotechnology product is based on a particular new technology; iv) there is also a difference in terms of the questions. While the IS refers to a product that is new or improved in a significant way, BUDS does not use that terminology for two reasons: the "new" aspect is covered by the reference period and the "significant" aspect is replaced by the link between the development of products or processes and the use of biotechnology.

single definition is broad, and therefore "covers all modern biotechnology but also many traditional or borderline activities, it is recommended that this definition be accompanied by the list-based definition". Biotechnology can be defined as *"the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services"* (OECD, 2005). Biotechnology is a dynamic activity found in many industries, characterized by diverse applications in a broad range of sectors: Human Health, Agriculture, Natural Resources, the Environment, Aquaculture and Food Processing. The following list of biotechnologies can be used as interpretative guidelines to the single definition[2]:

The list-based definition of biotechnology techniques

DNA/RNA: Genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology.

Proteins and other molecules: Sequencing/synthesis/engineering of proteins and peptides (including large molecule hormones); improved delivery methods for large molecule drugs; proteomics, protein isolation and purification, signaling, identification of cell receptors.

Cell and tissue culture and engineering: Cell/tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation.

Process biotechnology techniques: Fermentation using bioreactors, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurisation, bioremediation, biofiltration and phytoremediation.

Gene and RNA vectors: Gene therapy, viral vectors.

Bioinformatics: Construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology.

Nanobiotechnology: Applies the tools and processes of nano/microfabrication to build devices for studying biosystems and applications in drug delivery, diagnostics etc.

This document is a descriptive analysis of the results of the 2003 Biotechnology Use and Development Survey. The analysis is accompanied by data tables presented for all of Canada according to size of firm, activity sector and the region/province of location. The first section presents the distribution of the number of firms in Canada in 2003. Section 2 deals with key financial indicators of these firms, specifically, the growth of total revenue related to biotechnology activities, R&D expenditures for biotechnology, and the financing characteristics of biotechnology innovative firms. Section 3 describes the number of products/processes in development and on the market in 2003. Finally, section

2. This list of biotechnologies can be found in question 1 of the Biotechnology use and development survey 2003 (see appendix 2). The list is "indicative rather than exhaustive and is expected to change over time as data collection and biotechnology activities evolve" (OECD, 2005).

4 provides readers and users of the data with information on the methodology of the Survey.

I - Distribution of firms

There were 490 biotechnology innovative firms in Canada in 2003[3], compared to 375 in 2001, 358 in 1999 and 282 in 1997. Half of the increased number of firms between 2001 and 2003 resulted from the creation of companies during that period. Most of those companies are in the Human Health sector, are located in Ontario and Quebec and are small firms. The remainder of the increase is attributed to the fact that some firms that were solely users of biotechnology have become innovators or that some other companies covered by the survey decided to direct all or part of their activities to biotechnology in 2003.

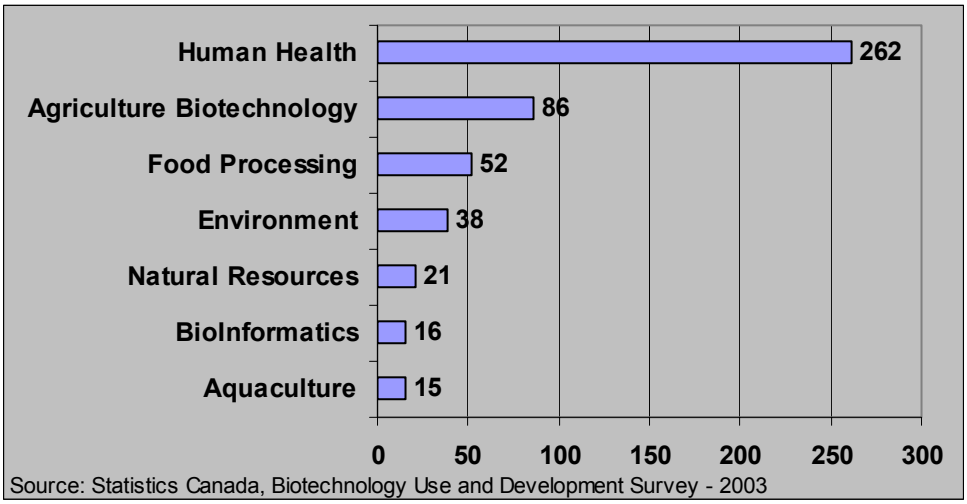
1.1 - Distribution by sector[4]

Between 2001 and 2003, the number of firms increased in all sectors of activity. The Human Health sector enjoyed the biggest increase rising from 197 firms in 2001 to 262 in 2003. More than half the growth in this sector was the result of the creation of companies between 2001 and 2003. The rest of the increase is due to firms that changed sector, or firms that were too small to be included in the 2001 Survey, or firms formed by university or hospital spin-offs. In 2003, there were 123 companies formed by spin-offs in the Human Health sector compared to 98 in 2001. The distribution of the number of firms by sector is very similar to the distribution in 2001. In both years, the Human Health sector represented 53% of the total number of biotechnology firms. The Agriculture Biotechnology sector was second (18% and 17% in 2003 and 2001 respectively) followed by the Food Processing sector (13% and 11% in 2003 and 2001 respectively). The Natural Resources sector which had declined in 2001 regained its 1999 level and counted 21 firms in 2003. The same situation applied in the Bioinformatics sector. The number of firms in this sector had declined in 2001, but the total increased in the most recent period. The Bioinformatics sector showed a net increase of 5 firms between 2001 and 2003; nearly all of that increase resulted from the creation of companies during this period.

3. These numbers were slightly revised after the initial publication of preliminary estimates in December 2004.

4. Firms are grouped by sector based on their main product. In 2003, sectors are based on the answers to question 12 of the Survey questionnaire. The questionnaire is available at appendix 2.

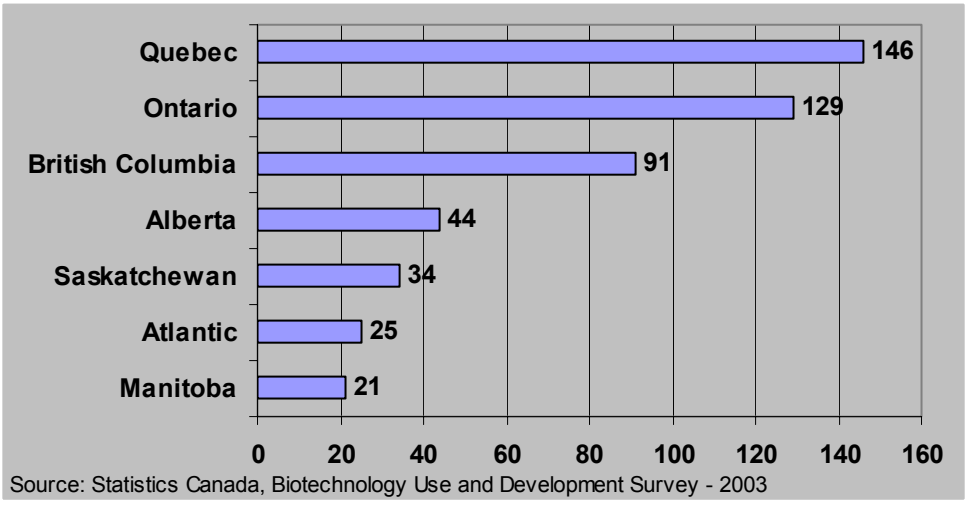
Figure 1: Number of innovative biotechnology firms, by sector of activity, 2003



1.2 - Distribution by province

The number of biotechnology firms increased in every province in 2003. Together, Quebec, Ontario and British Columbia account for nearly 75% of the total number of biotechnology firms. Quebec remains the home of most biotechnology firms in Canada, with a total of 146. Between 2001 and 2003, the number of biotechnology companies in this province increased by 16. However, Ontario had the biggest increase during this period. While the number of biotech firms in Ontario fell from 110 to 101 between 1999 and 2001, the province rebounded with an increase of its size by 28 companies between 2001and 2003. The same situation applied in British Columbia and Alberta, where a small decrease in 2001 was offset by significant gains in the number of firms in 2003.

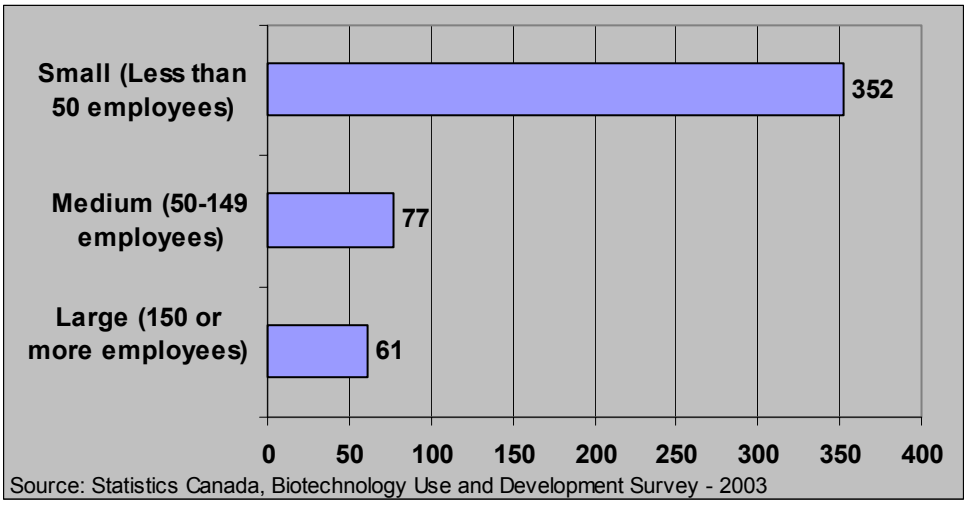
Figure 2: Number of innovative biotech firms, by province – 2003



1.3 - Distribution by size[5]

Small firms accounted for 72% of the total number in 2003, followed by medium-sized firms (16%) and large firms (13%). This distribution is similar to that in 2001, when small firms represented 71% of the total, medium-sized firms 17% and large firms 12%. Between 2001 and 2003, the number of firms increased in all size categories. The small firms category increased more than the other two (an increase of 88 firms), followed by the large firms category (increase of 18) and the medium-sized category (up by 15). More than half of the increase in the number of small firms resulted from the creation of companies between 2001 and 2003. In addition, 151 small firms were formed by spin-offs in 2003, an increase of 29% over 2001. The percentage of large firms continues to grow over time, rising from 11% in 1999 to 12% in 2001 and to 13% in 2003. The biotechnology innovative firms market continues to expand as small firms move into the larger size categories.

Figure 3: Number of innovative biotechnology firms, by size, 2003



5. The size of a company is determined by the number of employees. Small firms are those that employ less than 50 employees, medium-sized firms between 50 and 149 and large firms 150 employees and more.

Table 1: Distribution of biotechnology firms by sector, province and size, 2003

	Number of innovative biotechnology firms
A) Sector	
Human Health	262
Agriculture Biotechnology	86
Natural Resources	21
Environment	38
Aquaculture	15
BioInformatics	16
Food Processing	52
B) Province	
Quebec	146
Ontario	129
Manitoba	21
Saskatchewan	34
Alberta	44
British Columbia	91
Atlantic	25
C) Size	
Small (Less than 50 employees)	352
Medium (50-149 employees)	77
Large (150 or more employees)	61
D) Total Canada	**490**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

II - Financial profile

2.1 - Biotechnology and total revenues

2.1.1 - Number of firms declaring biotechnology revenue

Currently, many products and processes developed using biotechnology require a certification obtained through a regulatory process. Therefore, a firm developing a biotechnology product or process may not have any revenues or any revenues from biotechnology activities for some time. For this reason, the percentage of innovative firms reporting revenue, particularly from biotechnology activities, is of interest.

In 2003, 63% of innovative biotechnology firms reported revenues from biotechnology activities (308 out of 490 firms). In absolute terms, the number of firms reporting biotechnology revenues has increased, from 252 in 2001 to 308 in 2003. However, since the total number of firms developing biotechnology has increased considerably since 2001, as outlined in the previous section, the proportion of those firms generating revenue from biotechnology actually decreased slightly, from 67% in 2001 to 63% in 2003.

In 2003, 60% of small firms earned revenues from their biotechnology activities in comparison with 66% in 2001, while the percentages of medium-sized firms and large firms earning biotechnology revenues were the same as in 2001, 78% and 67% respectively.

Firms with biotechnology revenues are distributed across sectors as follows: almost half, or 47%, are in the Human Health sector, 20% are in Agriculture Biotechnology, 14% in Food Processing, 8% in the Environment sector, 4% are in Bioinformatics, 4% in Natural Resources and 3% in the Aquaculture sector.

Three quarters of firms that had biotechnology revenues in 2003 are in Quebec, Ontario and British Columbia, which have 92, 79 and 64 firms respectively. Alberta has 26 firms generating revenues from biotechnology activities, Saskatchewan 21, the Atlantic region 16 and Manitoba has 10. In Quebec, this represented no change in the number of firms declaring biotechnology revenues since 2001, but there was a 49% increase in British Columbia and a 21% increase in Ontario. There were also increases since 2001 in the number of firms earning revenue from biotechnology activities in all of the other provinces: 53% increase in Alberta, 43% increase in Manitoba, 40% in Saskatchewan and a 33% increase in the Atlantic region.

Almost four fifths (79%) of all firms in 2003 reported generating revenue from some source, up slightly from 77% in 2001.

While the Human Health sector has the largest share of firms developing biotechnology products and processes (53%, or 262 out of 490 firms), the firms in this sector are much less likely to be earning revenues than firms in other sectors and less likely than firms in all other sectors except Natural Resources to be earning revenues from biotechnology activities. In Human Health, 55% of firms reported revenue from biotechnology activities, in comparison with 85% of firms in Food Processing, 73% in Agriculture Biotechnology, 69% in Bioinformatics, 66% in Aquaculture and 52% in Natural Resources. Similarly, the percentage of firms in Human Health generating any revenue was lower than in most other sectors, 70%, compared with 100% in Aquaculture, 97% in Environment, 90% in Food Processing, 88% in Agriculture Biotechnology, 86% in Natural Resources and 81% in Bioinformatics. The lower percentage of firms in Human Health reporting revenue from biotechnology activities than in all other sectors (except Natural Resources) indicates that a greater percentage of biotechnology firms in this sector are firms which do not already have biotechnology products on the market.

Table 2: Number of innovative firms declaring biotech revenues and revenues by sector, province and size, 2003

	Number of innovative firms declaring biotech revenues	Number of innovative firms declaring revenues
A) Sector		
Human Health	144	183
Agriculture Biotechnology	63	76
Natural Resources	11	18
Environment	25	37
Aquaculture	10	15
BioInformatics	11	13
Food Processing	44	47
B) Province		
Quebec	92	112
Ontario	79	98
Manitoba	10	16
Saskatchewan	21	28
Alberta	26	30
British Columbia	64	83
Atlantic	16	22
C) Size		
Small (Less than 50 employees)	208	258
Medium (50-149 employees)	60	71
Large (150 or more employees)	40	60
D) Total Canada	**308**	**389**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

2.1.2 - Biotechnology revenues and total revenues

Biotechnology revenues increased by 7%

Revenues generated by innovative biotechnology firms are examined in this section in terms of revenue derived from biotechnology related activities and total revenue.

Biotechnology revenues for these firms amounted to $3.8 billion in 2003, a 7% increase over 2001, but almost doubling since 1999 and more than quadrupling since 1997. Large firms generated the majority of revenue earned from biotechnology activities in 2003, 64% or $2.5 billion, medium firms generated 24% and small firms 12%.

Human health still dominates with 52% of biotechnology revenues

In 2003, most biotechnology revenue (85%) was generated by firms in two sectors, Human Health and Food Processing. Although biotechnology revenues in the Human Health sector dropped 19% since 2001, firms in this sector were responsible for more than half of all biotechnology revenues in 2003 (52%). Biotechnology derived revenues from Food Processing firms represented 33% of all biotechnology revenue, more than doubling since 2001, from $581 million to $1.3 billion. Total revenues for this sector

have dropped dramatically since 2001, from $4.3 billion to $1.3 billion. In 2003, biotechnology revenues in Agricultural Biotechnology accounted for 11% of the total or $470 million, also almost doubling since 2001. Biotechnology revenue in the Environment, Natural Resources, Bioinformatics and Aquaculture sectors together account for the remaining 3% of biotechnology revenue.

In 2003, more than half of biotechnology related revenues, $2 billion, were generated by firms in Ontario, which represents a 47% increase since 2001. Firms in British Columbia had the second highest amount of biotechnology revenue in 2003, generating $779 million, an 88% increase over 2001. Biotechnology related revenues in Quebec amounted to $480 million, in Alberta $298 million, in Manitoba $145 million, Saskatchewan $94 million and the Atlantic region, $21 million.

Biotechnology revenues in Ontario, British Columbia, Alberta and Manitoba have grown steadily since 1997. Revenues in Quebec grew from $224 million in 1997 to $1.5 billion in 2001, but fell sharply to $480 million in 2003.[6] Biotechnology derived revenues grew more than four times in Saskatchewan since 2001, from $21 to $94 million, but in the Atlantic region these revenues have decreased steadily since 1997, from $34 to $21 million.

Total revenue

Revenue from biotechnology activities generated by firms developing biotechnology products and processes is much lower than their total revenue. Total revenue in 2003 amounted to $30.8 billion, while biotechnology revenues of $3.8 billion represent only 12.5% of this total. There was a 14% increase in total revenue since 2001, but the total revenue for these firms has more than doubled since 1997.

Large firms generated 87% of total revenue for these firms, or $26.7 billion, while small and medium firms generated $2.6 billion and $1.5 billion respectively. Biotechnology revenues represented a small part of total revenue for both large and small firms in 2003, 9% and 18% respectively, but represent 61% of the total revenue of medium firms. This percentage for medium firms has grown steadily from 29% since 1997. Although the percentage is much smaller for large firms, it has also grown, from 3% in 1997 to 9% in 2003. In contrast, in small firms, biotechnology revenues as a percentage of total revenues has fluctuated over the 1997-2003 period, between a low of 12% and a high of 45%. The reason that medium firms derive a larger percentage of their revenue from biotechnology than small firms is that many small firms have been established to develop biotechnology products and processes but may not derive any revenues from them since they are not yet on the market, while medium firms are more likely to have developed their products to the point where they are on the market and are earning revenue from them. Large firms, in contrast, are more likely to have adopted biotechnology activities

6. Part of the reason for this decrease is that a few firms which were responsible for an important part of biotechnology revenues in Quebec in 2001 ceased biotechnology development activities and therefore were not part of the survey results in 2003.

and products into an existing product line, therefore may be earning a much greater percentage of their revenues from those other products.

Unlike firms in other sectors, firms in the Food Processing sector derive most of their revenue from biotechnology activities. In 2003, 95% of revenue earned by firms in the Food Processing sector was derived from biotechnology activities. Firms in the Human Health sector also generate a much larger percentage of their revenue from biotechnology activities than firms in other sectors, 33%, compared to 13% in Bioinformatics, 9% in the Agriculture Biotechnology sector, 7% in the Aquaculture sector and less than 1% in the Environment sector and the Natural Resources sector.

In 2003, firms in Manitoba derived a larger share of their revenue from biotechnology activities than firms in other provinces, 37% or $145 million. Biotechnology revenues represented 23% of total revenue for firms in Alberta and about 18% of total revenue for firms in Ontario and in British Columbia. Firms in the Atlantic region derived 9% of total revenue from biotechnology activities, firms in Quebec 5% and firms in Saskatchewan 2%.

Table 3: Biotech revenues and total revenues by sector, province and size, 2003

	Biotech revenues		Total revenues	
	($000,000)		($000,000)	
A) Sector				
Human Health	1,999		5,972	
Agriculture Biotechnology	470		5,325	
Natural Resources	X		6,171	E
Environment	36		11,756	E
Aquaculture	14	E	209	E
BioInformatics	X		91	E
Food Processing	1,264		1,328	
B) Province				
Quebec	480		9,708	E
Ontario	2,026		11,032	E
Manitoba	145	E	390	E
Saskatchewan	94		3,891	
Alberta	298		1,275	
British Columbia	779		4,337	
Atlantic	21		220	E
C) Size				
Small (Less than 50 employees)	468		2,624	E
Medium (50-149 employees)	909		1,499	
Large (150 or more employees)	2,466		26,729	
D) Total Canada	**3,842**		**30,852**	

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

2.2 - Research and Development

2.2.1 - Biotechnology R&D expenditures

Firms developing biotechnology products and processes tripled their biotechnology R&D expenses between 1997 and 2003, from $494 million to $1.5 billion in 2003.

Firms in the Human Health sector accounted for the vast majority of biotechnology R&D expenditures (89%) in 2003, or $1.3 billion. Firms in Human Health have accounted for 83% or more of biotechnology R&D since 1997. Therefore, almost all of the increase in the amount spent on R&D for biotechnology since 1997 has been by firms in the Human Health sector (91% of the $993 million increase).

Other sectors account for only 11% of expenditures on biotechnology R&D: $66 million was spent in the Agriculture Biotechnology sector, $37 million in Environment, $26 million in Bioinformatics, $23 million in Food Processing, $13 million in Natural Resources and $7 million in the Aquaculture sector.

Approximately half of all biotechnology R&D expenditures in 2003 (47%) were made by medium-sized firms ($699 million), 33% by small firms ($495 million) and 20% ($293 million) by large firms.

Note, that while large firms generated 64% of biotechnology revenue, they made only one-fifth of the biotechnology R&D expenditures. In comparison, medium-sized firms earned a quarter of the revenue derived from biotechnology activities, but made nearly half of the biotechnology R&D expenditures. Similarly, small firms brought in only 12% of the biotechnology revenue, but made 33% of the R&D expenditures. Interestingly, although the percentage distribution of the number of firms between the three size categories in 2003 is almost identical to what it was in 1997, they spent similar amounts on R&D in 1997. However, in 2003, the amount spent on R&D by medium firms was more than five times as large as in 1997, for small firms it had increased to two and a half times the size, but for large firms it was only 65% greater. In other words, since 1997, medium firms have significantly increased the amount they spend on biotechnology R&D, as have small firms. In comparison, the amount spent on biotechnology R&D by large firms has actually dropped since 1999. Since small firms are often created to develop biotechnology products and processes, it is not surprising that they have a higher percentage of biotechnology R&D expenditures than they do of biotechnology revenues. It is not clear why there has been such a dramatic growth in R&D expenditures by medium firms, so that they now make almost half of the R&D expenditure on biotechnology. In contrast, it is likely[7] that the decrease in biotechnology R&D expenditures of large firms, while their biotechnology revenues are increasing is due to some extent to large firms purchasing intellectual property from small firms or purchasing the firms themselves, so that they are able to generate revenues with biotechnology products, but do not have R&D expenditures for those products.

7. This is an assumption that needs to be verified empirically.

2.2.2 - Total R&D Expenditures

Total R&D expenditures for firms developing biotechnology products and processes in 2003 was $2.3 billion, about the same as it was in 2001, but up from $1.2 billion in 1999 and from $927 million in 1997. As for R&D for biotechnology, the vast majority, 82%, of total R&D was by firms in the Human Health sector ($1.9 billion). The other 18% of total R&D expenditures was spread across sectors as follows: $187 million was spent in the Agriculture Biotechnology sector, $59 million in the Food Processing, $48 million in Environment, $31 million in the Bioinformatics sector and $88 million in Natural Resources and Aquaculture.

Total R&D expenditure by small, medium and large firms is very similar, $762, $801 and $726 million respectively, despite the vastly greater amount of revenue earned by large firms. The percentage of total R&D spent on biotechnology R&D by different sized firms is very similar to the percentages in 2001. In small firms R&D expenditure for biotechnology was 65% of total R&D expenditures, in medium firms it was 87% of the total and in large firms it was 40% (up from 35% in 2001). This suggests that small and especially medium-sized firms which develop biotechnology products and processes are more likely to be specialized in developing those products and processes, whereas large firms may have much more diversified R&D activity.

Firms in Human Health, Environment and Bioinformatics sectors made the majority of their R&D expenditures in 2003 on biotechnology R&D, with 70%, 78% and 84% respectively. The percentage of total R&D spent on biotechnology is much lower in Agriculture Biotechnology, 35%, and Food Processing, 39%.

As it is for biotechnology R&D in 2003, total R&D expenditures for firms developing biotechnology products and processes is highest in the three provinces of Ontario, Quebec and British Columbia with $785 million, $665 million and $401 million respectively. Alberta firms had $333 million in total R&D expenses, Manitoba $62 million, Saskatchewan $33 million and the Atlantic region, $10 million.

When comparing the percentage spent on biotechnology R&D to total R&D expenditures, the firms in British Columbia and Manitoba are most specialized, making 92% and 91% of their R&D expenditures on biotechnology R&D. In Quebec, Saskatchewan and the Atlantic region, between two-thirds and three quarters of total R&D goes to biotechnology R&D (74%, 72% and 67% respectively). However, Ontario firms developing biotechnology products and processes, which spent more than firms in other provinces in total R&D, had more diversified R&D activities, making 58% of total R&D expenditures on biotechnology. In Alberta, only 26% of total R&D in these firms was spent on biotechnology in 2003.

Table 4: Biotech R&D and total R&D expenditures by sector, province and size, 2003

	Biotech R&D expenditures		Total R&D expenditures	
	($000,000)		($000,000)	
A) Sector				
Human Health	1,316		1,876	
Agriculture Biotechnology	66		187	
Natural Resources	13		F	
Environment	37	E	48	E
Aquaculture	7		X	
BioInformatics	26	E	31	
Food Processing	23		59	
B) Province				
Quebec	490		665	
Ontario	453		785	
Manitoba	56	E	62	
Saskatchewan	23		33	
Alberta	88		333	E
British Columbia	370		401	
Atlantic	7		10	
C) Size				
Small (Less than 50 employees)	495		762	
Medium (50-149 employees)	699		801	
Large (150 or more employees)	293		725	
D) Total Canada	**1,487**		**2,288**	

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

2.3- Financing capital

2.3.1- Raising capital

A great deal of attention has been focused on the ability of biotechnology firms to raise capital and the challenges it involves. This section provides information on the number of firms attempting to raise capital, their success in raising capital and meeting their capital targets, as well as the sources of capital.

Across Canada, 52% of firms (254 of the 490) developing biotechnology products and processes attempted to raise capital in 2003 for biotechnology-related purposes. Of those, 70% or 178 firms succeeded in raising capital and 53% which raised capital were successful in meeting their target. These success rates are similar to those found in 1999 and 2001.

The total amount of capital raised by biotechnology firms for biotechnology-related purposes in 2003 was $1.7 billion, a 73% increase from 2001.

Most of the capital raised by biotechnology firms in 2003 was raised by firms in the Human Health sector. These firms were responsible for 84% of the total amount of capital raised, while firms in the other sectors raised a combined total of $233 million (14%). Firms in the Human Health were more likely than firms in other sectors to have applied for funding: sixty-seven percent of all firms that applied for funding were in the Human Health sector (53% of all biotechnology firms are in the Human Health sector). Seventy-six percent of the firms in this sector applying for funding were successful and 55% of those firms were successful in meeting their target.

Of the total amount of capital raised, small firms earned 41% or $693 million, medium firms 31% and large firms 28%. In 2001, small firms earned 53% of the total, medium-sized firms 38% and large firms 9%. In 2003, small firms were much more likely to have applied for capital than medium-sized and large firms; 59% of small firms applied for capital compared to 42% of medium firms and 21% of large firms. Medium and large firms, however, were more successful in raising capital than small firms; 91% and 77% of medium and large firms respectively compared to 67% for small firms. Medium and large firms were also more successful than small firms in meeting their capital targets: only 49% of small firms receiving capital met their financing targets successfully, compared to 69% of medium firms and 70% of large firms.

Almost all of the $1.7 billion of the capital raised by biotechnology firms (96%) was raised in four provinces (British Columbia, Quebec, Ontario and Alberta). Firms in BC and Quebec raised $579 million and $563 million respectively. Firms in Ontario raised $253 million and firms in Alberta raised $235 million. Firms in Alberta and British Columbia that received funding in 2003 were more likely to have met their financing targets, 81% and 63% respectively, than firms receiving funding in Quebec and Ontario where 48% and 46% of firms respectively were able to reach their targets.

Table 5: Amount of capital raised, number of firms attempting to raise capital, that were successful in raising capital, that met their target and percentage of firms that reached target by sector, province and size, 2003

	Amount of capital raised	Attempted to raise capital	Successful in raising capital	Met target	Percentage of firms that reached target
	($000,000)	Number	Number	Number	(%)
A) Sector					
Human Health	1,460	170	130	72	55
Agriculture Biotechnology	133	31	15	8	53
Natural Resources	F	10	X	X	..
Environment	16 E	11	10	6	60
Aquaculture	X	8	5 E	0	0
BioInformatics	50 E	10	X	X E	..
Food Processing	17	14	11	6	55
B) Province					
Quebec	563	83	63	30	48
Ontario	253	63	46	21	46
Manitoba	X	8	6	5	83
Saskatchewan	X	16	6	X	X
Alberta	235	22	16	13	81
British Columbia	579	46	30	19	63
Atlantic	3	16	10	X	X
C) Size					
Small (Less than 50 employees)	693	209	139	68	49
Medium (50-149 employees)	533	32	29	20	69
Large (150 or more employees)	467 E	13	10	7 E	70
D) Total Canada	**1,694**	**254**	**178**	**94**	**53**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

2.3.2 - Sources of capital

Firms were asked to provide the sources of capital raised in 2003. This section reports on the share of total capital raised from each source.[8] These sources include Canadian-based venture capital, American-based venture capital, conventional sources (i.e. banks), angel investors/family, government sources, private placement, initial public offering (IPO), secondary public offering (SPO) and collaborative arrangements and alliances.

There has been a change in the primary source of funding for these firms between 2001 and 2003. Most of the $1.7 billion in capital raised by biotechnology firms in Canada in 2003 came from four sources: Private placement (29%), Canadian-based venture capital (14%), Secondary public offering (13%) and Other (20%). In comparison, the largest share of capital raised in 2001 (42%) came from Canadian-based venture capital. The remaining sources of capital raised in 2003 were American-based venture capital (8%), Conventional sources (6%), Government sources (5%), IPO's (2%) and Collaborative arrangements and alliances (1%).

For small firms in 2003, the single largest source of capital was Canadian-based venture capital, at 30%, however this was down considerably from 57% in 2001. The rest was distributed across other several sources; American-based venture capital (19%), Private placement (14%), Secondary public offering (14%), Government sources (7%), Angel investor/family (5%), Initial public offering (4%), Collaborative arrangements and alliances (2%) and other sources (4%).

The amount of capital raised by medium firms in 2003 from Canadian-based venture capital was only 2%, down from 26% in 2001. These firms derived most of their capital from unspecified types of sources (other), 57%, and from secondary public offerings, 22%.

Capital raised by large firms was raised from only four sources: Private placements, Conventional sources, Canadian-based venture capital and Government sources (percentages suppressed due to confidentiality). Large firms did not raise capital from any of the other sources.

8. In McNiven et al. (2003) page 18, the percentages from each source were expressed as the average instead of the share.

Table 6: Sources of funding & percentage of funds from each source by sector, province and size, 2003

	Share									
	Canadian based venture capital	American based venture capital	Conventional sources	Angel investors/ Family	Government sources	Private placement	IPO (Initial public offering)	SPO (Secondary public offering)	Collaborative arrangements	Other
	%	%	%	%	%	%	%	%	%	%
A) Sector										
Human Health	15	9	7	2	4	33[E]	F	15	1	X
Agriculture Biotechnology	3[E]	0	0	F	F	2	0	0	0	F
Natural Resources	F	0	0	F	F	F	0	0	0	0
Environment	14[E]	0	F	F	0	16[E]	F	0	0	0
Aquaculture	F	F	F	0	F	0	0	0	0	F
BioInformatics	F	0	0	F	F	0	0	0	F	F
Food Processing	22[E]	0	F	0	1[E]	69[E]	0	0	0	F
B) Province										
Quebec	23	7[E]	F	1	13	18[E]	F	F	2[E]	29
Ontario	21	16[E]	F	9	6	F	0	F	0	11[E]
Manitoba	F	0	0	0	0	45[E]	F	0	0	0
Saskatchewan	F	0	0	3[E]	0	6[E]	0	0	0	F
Alberta	0	0	0	F	F	27[E]	0	F	0	F
British Columbia	10[E]	9[E]	F	1[E]	F	F	0	18[E]	1	F
Atlantic	0	0	F	47[E]	X	0	0	0	0	0
C) Size										
Small (Less than 50 employees)	30	19	1	5	7	14	4	14	2	4
Medium (50-149 employees)	2	0	5[E]	0	X	F	0	22	0	57
Large (150 or more employees)	5	0	15[E]	0	F	F	0	0	0	0
D) Total Canada	**14**	**8**	**6**	**2**	**5**	**29[E]**	**2[E]**	**13**	**1**	**20**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

2.3.3 - Reasons for lenders limiting or refusing request for capital

In 2003, of the 490 innovative biotechnology firms in Canada, 254 attempted to raise capital. Of these, 70% were successful in raising capital and 53% of the firms that were successful in raising capital met their target. This is a slight decrease from 2001 where 56% of firms that were able to raise capital met their target.

The limited success of biotechnology firms in raising capital was due in 96 cases to the fact that "capital was not available due to market conditions". In 68 cases, the lender needed further product/process development and in 59 cases lenders needed further product development or proof of concept. The importance of each reason is very similar to what was found in 2001.

Small firms continue to suffer the most from these refusals or limitations. Of the 96 cases where lenders limited or refused capital due to market conditions, 93% came from small-sized firms. These firms were refused capital for a variety of reasons, but mainly because of market conditions (89 cases), to the fact that lenders needed further product/process development and required product development and proof of concept[9]. Large firms were refused capital for 2 reasons only: market conditions and "other"; medium-sized firms were also mainly refused capital because of market conditions, and none of those firms were refused capital due to the fact that the biotechnology product line or portfolio is limited in scope, insufficient specific management skills/expertise or to the fact that the lender does not fund development projects.

The limiting or refusing of funding because of i) lack of capital due to market conditions, ii) requirement of further product development or proof of concept, and iii) insufficient development of biotechnology product/process affected firms across all the provinces and sectors. These findings are in line with those found in 2001 (McNiven et al, 2003).

9. Numbers for these two reasons are suppressed due to confidentiality. However, "biotechnology products/process not sufficiently developed" is the second most important reason given by lenders for limiting or refusing capital to small firms and is followed by "Further product development or proof of concept required".

Table 7: Reasons given by lender in limiting or refusing firms' request for capital, Canada and by size, 2003

	Number
Canada	
Biotechnology product/process not sufficiently developed	68
Biotechnology product line or portfolio limited in scope	17
Insufficient specific management skills/expertise	11
Capital not available due to market conditions	96
Further product development or proof of concept required	59
Lender does not fund development projects	39
Other	33
Size	
Small (Less than 50 employees)	
Biotechnology product/process not sufficiently developed	X
Biotechnology product line or portfolio limited in scope	17
Insufficient specific management skills/expertise	11
Capital not available due to market conditions	89
Further product development or proof of concept required	X
Lender does not fund development projects	39
Other	25
Medium (50-149 employees)	
Biotechnology product/process not sufficiently developed	X
Biotechnology product line or portfolio limited in scope	0
Insufficient specific management skills/expertise	0
Capital not available due to market conditions	X
Further product development or proof of concept required	X
Lender does not fund development projects	0
Other	X
Large (150 or more employees)	
Biotechnology product/process not sufficiently developed	0
Biotechnology product line or portfolio limited in scope	0
Insufficient specific management skills/expertise	0
Capital not available due to market conditions	X
Further product development or proof of concept required	0
Lender does not fund development projects	0
Other	X

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

III - Human resources in industrial biotechnology

In 2003, Canada had 11,863 employees with biotechnology-related activities representing 16% of total employment of Canadian biotechnology innovative companies. Employment changed considerably between biotechnology surveys. Between 1997 and 1999, despite an increase in the number of firms and in the key variables (revenues, R&D, capital, etc.), biotechnology companies saw a 15% decrease of their human resources with biotechnology-related activities. Between 1999 and 2001, Canada had 54% more biotechnology employees. This number remained unchanged between 2001 and 2003 (from 11,897 to 11,863 in 2001 and 2003 respectively).

Biotechnology is characterized by highly-skilled human resources with research responsibilities. Data from the Biotechnology Use and Development Survey indicates that in 2003, more than half of the number of employees with biotechnology-related responsibilities was in the scientific research/direction and technician positions. This section looks at the characteristics of human resources in biotechnology innovators for 2003 in Canada, by sector, province and size.

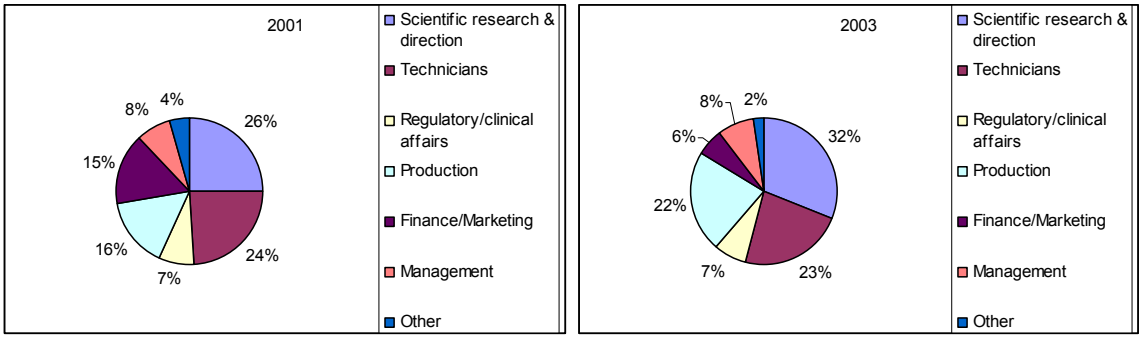
3.1 - Human resources in industrial biotechnology: Canada

Biotechnology is a knowledge-based activity; its human resources are therefore intensive with highly-skilled positions. In 2003, 54% of all employees with biotechnology-related responsibilities were in the scientific research/direction and technician positions, up from 49% in 2001. They are followed by the production position which represents, in 2003, 22% of biotechnology employment. There is an increase in biotechnology employees with production-related responsibilities since the percentage of employees with production-related responsibilities to the overall biotechnology employment increased every year since 1999 (it went from 2% in 1999 to 16% in 2001 to 22% in 2003). This change in the human resources composition could mean that biotechnology firms are maturing.

Data indicates that Canadian biotechnology innovative firms tend to hire production employees on a part-time basis and scientific research positions on a full-time basis. In fact, in 2003, employees in the production category accounted for the largest share of total part-time jobs (24%) whereas scientific research and direction were the main contributors in full-time employment (32%). This trend is very similar to the one found in 2001.

Between 1999 and 2001, when Canada saw a 54% increase in the number of employees with biotechnology-related activities, the finance/marketing category had more than doubled its staff. Inversely, the slight decrease in the number of biotech employees between 2001 and 2003 was accompanied by a 61% decrease in the number of jobs in the finance/marketing category.

Figure 4: Distribution of biotechnology-related employment by position type, Canada, 2001 and 2003



Source: Statistics Canada, Biotechnology Use & Development Survey - 2001 and 2003

Table 8: Number of full and part-time employees, Canada, 2001 and 2003

	2001			2003		
	Full-time	Part-time	Total	Full-time	Part-time	Total
Scientific research & direction	2,893	92	2,985	3,488	195	3,683
Technicians	2,646	221	2,867	2,576	182	2,758
Regulatory/clinical affairs	833	55	888	747	91	838
Production	1,639	232	1,871	2,404	244	2,648
Finance/Marketing	1,751	66	1,817	560	142	702
Management	869	68	937	828	153	981
Other	490	42	532	237	16	253
Total	**11,121**	**776**	**11,897**	**10,840**	**1,023**	**11,863**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2001 and 2003

3.2 - Human resources in industrial biotechnology: Sector

Of the 11,863 employees with biotechnology-related activities, 78% were in the Human Health sector, 9% in the Agriculture sector and 6% in the Food Processing sector. Firms in Human Health have the highest percentage of biotechnology personnel to total employment compared to other sectors: in 2003, they dedicated 58% of their total workforce to biotechnology, compared to 54% in 2001. They are followed by firms in the Bioinformatics sector, who although account for only 2% of total biotechnology employment, dedicate 37% of their workforce to biotechnology.

Firms in the Environment sector seem to dedicate fewer employees to biotechnology. The number of employees with biotech-related employees to total employees in this sector went from 0.08 in 1999 to 0.03 in 2001 to 0.01 in 2003.

The decrease in the number of employees in the finance/marketing category came mostly from full-time positions in the Human Health sector. In fact, the number of employees in full-time finance/marketing positions decreased by 69% between 2001 and 2003, whereas the number of employees with part-time finance/marketing positions more than doubled for this sector.

3.3 - Human resources in industrial biotechnology: Quebec leads

Although the number of employees with biotechnology-related activities decreased in Quebec between 2001 and 2003 (-63%)[10], this province continues to employ the majority of employees with biotechnology-related activities (31%) followed by Ontario (30%) and British Columbia (18%).

Quebec continues to employ the majority of its biotechnology workforce in highly skilled jobs (i.e. scientific research/direction and technicians). In fact, despite the decrease in the number of employees with biotechnology-related positions in Quebec between 2001 and 2003, the proportion of highly skilled employees in this province has slightly increased from 57% in 2001 to 59% in 2003. The number of biotechnology employees with part-time responsibilities decreased by nearly 60% between 2001 and 2003 and the number of employees with full-time responsibilities decreased by 18%. The decrease in the number of part-time responsibilities for Quebec is essentially due to the decrease in the number of employees with part-time production positions (-85%) followed by part-time technicians (-65%).

Firms in Manitoba employ the largest share of their total workforce in biotechnology (85%) followed by firms in Alberta (38%). Firms in Ontario employed 47% of their total workforce in biotechnology in 2001 but this proportion is only 15% in 2003.

3.4 - Human resources in industrial biotechnology: Size

The number of employees with biotechnology-related activities increased in small and medium-sized firms (15% and 16% respectively) between 2001 and 2003. Despite the decrease in the number of biotechnology employees between 2001 and 2003 for large firms (-19%), they continue to employ the majority of the biotechnology workforce. Of the 11,863 employees with biotechnology-related responsibilities, 38% are in large firms, 32% in medium-sized firms and 31% in small firms.

However, large firms are the least intensive in terms of biotechnology employment. Only 7% of their total workforce is dedicated to biotechnology whereas 58% of total employment in medium-sized firms is dedicated to biotechnology activities and 70% in small firms.

Nearly 65% of the total biotechnology workforce in small firms is constituted of scientific research/direction and technicians positions, compared to 59% in medium-sized firms and 42% in large firms.

10. The decrease in the number of employees with biotechnology-related activities between 2001 and 2003 in Quebec is in parallel with the decrease in biotechnology revenues for this province. The reason for the decrease in these two variables is the same: part of the reason for this decrease is that a few firms which were responsible for an important part of biotechnology revenues and employment in Quebec in 2001 ceased biotechnology development activities and therefore was not part of the survey results in 2003.

Table 9: Number of biotech employees and total employees by sector, province and size, 2003

	Number of employees with biotechnology-related responsibilities		Total number of Canadian employees	
A) Sector				
Human Health	9,255		16,069	
Agriculture Biotechnology	1,085		6,446	
Natural Resources	120		13,676	E
Environment	246		31,630	E
Aquaculture	167	E	731	E
BioInformatics	244		658	E
Food Processing	747		6,238	
B) Province				
Quebec	3,700		30,094	
Ontario	3,508		25,716	
Manitoba	1,213	E	1,429	E
Saskatchewan	337		5,423	
Alberta	727		1,899	
British Columbia	2,173		10,042	
Atlantic	206		845	E
C) Size				
Small (Less than 50 employees)	3,619		5,184	
Medium (50-149 employees)	3,746		6,416	
Large (150 or more employees)	4,498		63,848	
D) Total Canada	**11,863**		**75,448**	

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

Table 10: Number of full and part-time employees by sector, 2003

	Scientific research & direction Full time	Scientific research & direction Part time	Techni-cians Full time	Techni-cians Part time	Regulatory/ Clinical affairs Full time	Regulatory/ Clinical affairs Part time	Produc-tion Full time	Produc-tion Part time	Finance/ Marketing Full time	Finance/ Marketing Part time	Manage-ment Full time	Manage-ment Part time	Other Full time	Other Part time	Total Full time	Total Part time
Human health	3,059	107[E]	1,804	103[E]	676	67	1,788	F	476	115	636	110	217[E]	X	**8,656**	**599**
Agriculture biotechnology	216	40	335	23	X	15	245	28[E]	46	17	68	11	X	8[E]	**943**	**142**
Natural resources	20	X	41[E]	14[E]	0	F	14[E]	X	X	0	8[E]	5[E]	0	0	**X**	**X**
Environment	27	21	66	24	X	0	43	23	X	0	17	16	0	0	**163**	**83**
Aquaculture	30	X	22	X	X	0	10[E]	F	10[E]	X	21[E]	0	X	0	**X**	**F**
BioInformatics	33	12	108	F	F	0	18	0	X	0	8	0	0	0	**227**	**18**
Food processing	103	8	200	9	X	X	286	38	X	X	70	12[E]	0	X	**669**	**78**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

Table 11: Number of full and part-time employees by province, 2003

	Scientific research & direction Full time	Scientific research & direction Part time	Techni-cians Full time	Techni-cians Part time	Regulatory/ Clinical affairs Full time	Regulatory/ Clinical affairs Part time	Produc-tion Full time	Produc-tion Part time	Finance/ Marketing Full time	Finance/ Marketing Part time	Manage-ment Full time	Manage-ment Part time	Other Full time	Other Part time	Total Full time	Total Part time
Quebec	952	39	1,150	50	222	F	633	27	172	8	X	26	F	X	**3,536**	**163**
Ontario	943	40	534	31	240	38	1,158[E]	64	180	16	172	X	37	X	**3,265**	**243**
Manitoba	F	F	62	F	14	F	267[E]	F	F	F	44	F	0	0	**X**	**F**
Saskatchewan	110	9	121	17	X	0	34	X	X	0	18	10	0	X	**293**	**44**
Alberta	181	X	186	13[E]	67[E]	F	58	F	43	0	109	5[E]	50[E]	0	**693**	**34**
British Columbia	710	39	498	21	202[E]	10[E]	236	X	138	94[E]	X	30[E]	F	X	**1,977**	**196**
Atlantic	X	F	25	0	X	5	19	F	8[E]	5[E]	32	X	X	0	**X**	**X**
Canada	**3,488**	**195**	**2,576**	**182**	**747**	**91**	**2,404**	**244**	**560**	**142**	**828**	**153**	**237**	**15**	**10,840**	**1,023**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

Table 12: Number of full and part-time employees by size, 2003

	Scientific research & direction Full time	Scientific research & direction Part time	Techni-cians Full time	Techni-cians Part time	Regulatory/ Clinical affairs Full time	Regulatory/ Clinical affairs Part time	Produc-tion Full time	Produc-tion Part time	Finance/ Marketing Full time	Finance/ Marketing Part time	Manage-ment Full time	Manage-ment Part time	Other Full time	Other Part time	Total Full time	Total Part time
Small	1,213	82	1,004	59	132	14	373	X	193	28	346	74	23[E]	X	**3,283**	**336**
Medium	1,078	77[E]	959	84[E]	260	46	368	F	277	X	296	46[E]	67[E]	0	**3,306**	**441**
Large	1,198	35[E]	613	39	355	31[E]	1,662	77	90	F	186	34[E]	147[E]	X	**4,251**	**247**

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

IV - The product pipeline: biotechnology products/processes profile

The distribution of biotechnology is not limited to any singular industry or process, but instead, biotechnology products range through a diverse set of industries and areas of interest from agricultural initiatives to increase crop yields, human genome research, drug discovery, innovative medical procedures, Bioinformatics, to waste and Environmental management. Some of these are subject to intense regulatory processes while others are not. A significant measure of the vitality of biotechnology activities is the products pipeline i.e. the products in development for the marketplace. The product pipeline[11] is a significant indicator of the future growth of a sector. Significant time and cost factors as well as a high attrition rate in bringing a single product to market characterize biotechnology. A healthy pipeline is essential for the future of biotechnology activities.

Several changes in the product data are evident. Pre-survey and post-survey interviews and follow-up with respondents provide some insight and explanations. Some small biotechnology firms reported that their goal was only to develop concepts and products to the point that they could be sold to larger entities for clinical trials and final commercialization. This phenomenon has also been reported in the European biotechnology community. Other firms reported restructuring of their operations, no longer developing products, but, instead sell biotechnology products or products developed in part using biotechnology processes. These firms are not included in the innovative group of biotechnology firms. In addition a number of firms relocated operations to other countries and no longer perform R&D in Canada.

A further group of firms were acquired by foreign firms and their presence in Canada has been modified, and in several cases operations have been reduced to sales offices, ending research & development activities in Canada. In addition firms relocated provincially. Products are assigned to the 'home' province of the firm, but that does not preclude that fact they may be available in other provinces or regions. Finally, some firms restructured the composition of their product's line, reducing the number of products/processes in some of the projects or categories of products. This provides a partial explanation of changes in the structure of the product pipeline but additional research is required.

Biotechnology firms reported 17,065 biotechnology products/processes at all stages[12] of development and on market. Of these, 4,960 were in the research and development stage, and over 2/3 (11,046) were approved, in the market or in production. There is a 5% decrease from 2001 in the total number of products, mainly in the R&D stage with a 17% decrease, where declines in the number of products in R&D for Human Health were 526 and Agriculture was 717. The Regulatory stage experienced an 84% decline from 1,663 to

11. The pipeline is the total number of unique products and/or processes reported by each firm and include regulated and non-regulated products and/or processes.
12. The questionnaire used the following stages of development 1) Research & Development 2) Pre-clinical trials/Confined field trials 3) Regulatory phase/Unconfined release assessment 4) Approved/On market/In production. Examples of what is included in each sector can be found in question 12 of the questionnaire, Appendix 2.

254 products. These, however, may account for the increase in total products on market which climbed 14% (1,385) to 11,046 products. It is interesting to notice that in the Agriculture sector, the number of products in products or in the market has more than doubled compared to 2001 (from 652 to 1,573) while the number of products in the regulatory phase has decreased. This increase in the number of products in the market has translated in a 92% growth in biotechnology revenues between 2001 and 2003 in the Agriculture sector.

In Atlantic Canada, the total number of products increased from 139 in 2001 to 413 in 2003 an increase of 269%. R&D stage products grew 280% from 63 to 241 and total number of products on market grew from 38 to 143, representing a 276% increase. There are changes in the product pipeline in Quebec where the total number of products dropped from 11,072 in 2001 to 8,853 in 2003. The R&D stage declined by 725 products or 38%, while the on market stage saw a reduction of 7.5% from 8,087 to 7,485. In Ontario the total number of products climbed 90% from 2,376 in 2001 to 4,524 in 2003. All stages experienced growth with the largest increase noted in the R&D stage which grew 65% from 1,810 products in 2001 to 2,992 in 2003. The number of products on market more than doubled from 405 in 2001 to 969.

In Manitoba total products dropped from 2,376 to 85 (an average of 4 products/processes per company). Confidentiality issues prevent a concise analysis, however it is clear that there is a significant decrease in the number of products in the regulatory phase between 2001 and 2003; nonetheless, the reader is advised to consider comments in earlier sections of this paper. Saskatchewan's total number of products grew by 512, to 679 in 2003. The main growth came in the on market stage. Due to confidentially issues comparisons cannot be made with 2001 for the other sectors. Alberta saw the number of products climb 85% from 131 to 242, representing growth in all sectors but especially in the R&D and on market stages.

In British Columbia the total number of products grew 26%, from 1,789 to 2,269 between 2001 and 2003. The total number of products at the R&D stage dropped in half from 576 to 292. The total number of products on market grew from 1,048 to 1,875 representing a 78% increase between 2001 and 2003.

Distribution of products based on size underwent a major change with the small category decreasing from 10,144 to 5,590, the medium size firm category decreasing from 5,078 to 2,201 and the large category increasing by 6,476 products to 9,274. The changes in the number of products/processes in the smaller size categories should be considered as transfers rather than decreases. Some companies shifted from smaller to larger size categories between 2001 and 2003, translating in an increase in the number of products/processes in the large size category. Most of this change is found in the "on market stage". However at the R&D stage small firms saw their number of products in development increase 49% to 3,345 products and decrease for medium and large sized firms.

Overall there are numerous changes in the distribution of products by stage of development and firm distribution. These can be partially attributed to changes in firm focus, ownership and restructuring.

Table 13: Number of biotech products/processes by development stage by sector, province and size, 2003

	Number of biotechnolgy products/processes by development stage				
	Research & Development	Pre-clinical trials/Confined field trials	Regulatory phase/Unconfined release assessment	Approved/ On market/ In production	Total Products/ Processes
	Number	Number	Number	Number	Number
A) Sector					
Human Health	1,491	316	174	8,711 E	10,692 E
Agriculture Biotechnology	2,773 E	417 E	50	1,573	4,813
Natural Resources	X	15	X E	12	86
Environment	109	18	9	82	218
Aquaculture	F	13 E	X E	21 E	231 E
BioInformatics	196	6	0	203 E	404
Food Processing	144	22	12	444	622
B) Province					
Atlantic	241 E	20	8	143	413
Quebec	1,160	139	69	7,485 E	8,853 E
Ontario	2,992 E	479 E	83	969	4,524
Manitoba	31	13	16	25	85
Saskatchewan	122	63 E	23	472	679
Alberta	121	28	16	76 E	242
British Columbia	292	63	39	1,875 E	2,269 E
C) Size					
Small (Less than 50 employees)	3,345	596	148	1,502	5,590
Medium (50-149 employees)	324	74	52	1,751 E	2,201 E
Large (150 or more employees)	1,291	136	54	7,793 E	9,274 E
D) Total Canada	4,960	806	254	11,046 E	17,065 E

Source: Statistics Canada, Biotechnology Use & Development Survey - 2003

Summary

The objective of this paper was to describe Canadian biotechnology activity in 2003. Data shows that the number of biotechnology firms has significantly increased between the last two surveys going from 375 in 2001 to 490 in 2003. Despite the increase in the number of firms, biotechnology revenues increased by only 7% and the number of employees with biotechnology-related activities remained unchanged (from 11,897 in 2001 to 11,863 in 2003). In fact, half of the net increase in the number of firms between 2001 and 2003 comes from firms created during this period. These firms are mainly small and therefore their contribution in terms of biotechnology revenues and employment is marginal.

Also, between 2001 and 2003 a certain number of firms that had a large contribution to biotechnology activity in 2001 (biotech revenues, employment, etc.) were not part of the survey results in 2003 because they had either been acquired by foreign companies or had ceased their biotechnology activities. Despite the fact that the number of those firms that left is small their exit had an impact on biotechnology revenues or employment.

In 2003, biotechnology firms spent $1.5 billion in biotechnology R&D, an 11% increase from 2001. For each dollar invested in biotechnology R&D, firms generated $2.57 in biotech revenue, compared to $1.65 in 1997, $2.36 in 1999 and $2.67 in 2001.

To support this growth, firms needed additional capital. In 2003, 254 firms attempted to raise capital for biotechnology activities and 178 were successful; these firms raised a total of $1.7 billion in capital, a 73% increase from 2001. Among the firms that raised capital in 2003, almost 53% reached their target compared to 56% in 2001. Small firms, however, continue to face difficulties in raising capital compared to their counterparts. In 2003, of the 139 small firms that said they succeeded in raising capital, nearly 49% said they reached their target. That compares with a rate of 69% for medium-size firms and 70% for large firms.

Finally, biotechnology firms reported 17,065 products/processes at all stages of development in 2003, a 5% decrease from 2001 but a 91% increase from 1997. Of the 17,065 products/processes, 29% were in research and development stages and 71% were approved, in production or in the market. Part of the reasons for the changes in the pipeline data can be summarized as follows:

- Small firms that decided to focus only on developing concepts and products to the point that they could be sold to larger entities for clinical trials and final commercialization;
- Firms that restructured their operations and that no longer develop products, but, instead sell biotechnology products or products developed in part using biotechnology processes;
- Firms that were acquired by foreign firms; their presence in Canada has been modified;
- Firms that restructured the composition of their product's line, reducing the number of products/processes in some of the projects or categories of products.

This study was an overview on biotechnology activity in Canada in 2003. Additional data from the 2003 Biotechnology use and development survey is available on request. Statistics Canada will start consultation for the 2005 Biotechnology Use and Development Survey end of the fall of 2005. Research papers on human resources, outsourcing, financing and patents are under way or will be soon.

References:

OECD. (2005). "Biotechnology Statistics Framework", *Forthcoming*.

McNiven, C., Raoub, L. and Traore, N. (2003). " Features of Canadian biotech innovative firms: results from the Biotechnology Use and Development Survey - 2001", Working Paper, No. 5, Catalogue No. 88F0006XIE, SIEID, Ottawa : Statistics Canada.

Appendix 1 - Methodology

Description

The Biotechnology Use and Development Survey provides information on firms that use biotechnology to develop new products or processes in Canada. Since innovative biotechnology firms represent a rare population, in the sense that biotechnology is a difficult activity to target because it is not linked to a particular industry, the 2003 Biotechnology Use and Development Survey employs the same method used for the 2001 Survey, which is a survey methodology in two stages. This allows us to cover a broader range of the population and to include companies that were created between 2001 and 2003 or those in business in 2001 but which did not use or have not yet developed the biotechnology and that have decided to take their activities in another direction. While the first stage questionnaire was simple, the second stage collected more detailed information.

The first stage questionnaire was distributed in the winter of 2004 by mail to all firms on a pre-determined list of NAICS codes in which firms are likely to use biotechnology or develop bioproducts. Nearly 10,640 questionnaires were sent out in the first stage. Companies that answered “yes” to one of the following questions participated in the complete survey (second stage): “does your firm use/develop biotechnology activities/products” and “does your company develop bioproducts.”

The second stage questionnaire was sent by mail to companies that had answered “yes” to at least one of the previous questions and to firms included on a list of companies thought to be actively involved in biotechnology. In all, there were about 1,100 respondents. The questionnaire collected data on the firms' revenues, research and development activities, imports and exports, human resources, strategies, intellectual property issues, and use and development of biotechnologies. A section on bioproducts was also added in 2003.

The survey excluded not-for-profit organizations, universities, government laboratories, hospitals, companies that use only traditional biotechnologies, and service sector firms. In addition, respondents had at least $100,000 in R&D expenditures and, according to the Business Register, revenues in excess of $250,000.

Stratification

Stratification was made using these 3 variables: NAICS, province and size. Size is based on the number of employees of the provincial enterprise: i) 0-49 employees; ii) 50-149 employees and iii) 150 employees and more.

Imputation

Because of the qualitative nature of most of the questions, the "hot deck" imputation method was used for the majority of the questions. The imputation groups were formed based on the province, the sector of activity and the size of the provincial enterprise. The question related to

human resources (Q2) was the first to be imputed. Size was based on the number of employees from the frame. For the other questions, size was based on the number of employees found in question 2 (Q2). Certain questions required a different strategy.

Estimation

Firms were selected to provide a representative sample based on size, industry and province. In order to palliate for non-response, an adjustment factor for weighting was applied to the homogeneous response groups created from the sector of activity and the size of the statistical units. This adjustment factor is used as a final weight to produce estimates. To calculate the variance, a stratified random sample formula was used. The strata were formed by the respondent homogeneous groups mentioned previously.

Data accuracy

Firms were selected to provide a representative sample based on size, industry and province. The finalized response rate or participation rate for the full survey (second phase) was 80% and the response rate approximately 70%. The results were weighted to reflect the entire count of firms in the selected industries. Estimates were vetted for compliance with confidentiality rules. Data quality was assessed in consultation with the methodology team, and when the data were unreliable, they were not published.

Quality indicators

The coefficient of variation (CV) is used to measure the precision of the estimates. A CV is therefore calculated for every estimate in the tables. The CV is an indication of the standard deviation or standard error expressed as a percentage of the estimate. It is a relative measure of estimate precision. The larger the CV the larger the variation and the less reliable the estimate.

The data reliability is based on the following symbol convention for quality indicator interpretation:

CV	Quality indicator symbol
< 35%	No quality indicator symbol required. Data is reliable or very reliable.
> or = 35% and < 50%	E: use with caution
> or = 50%	F: too unreliable to be published (estimate is suppressed)

When the estimate is a percentage (%), the quality measure used is the standard deviation:

STD	Quality indicator symbol
< 15%	No quality indicator symbol required. Data is reliable or very reliable.
> or = 15%	E: use with caution
> 15%	F: too unreliable to be published (estimate is suppressed)

Appendix 2: Questionnaires 1 and 2

Science, Innovation and Electronic Information Division

Biotechnology Use and Development Survey - 2003

Confidential once completed

Collected under the authority of the *Statistics Act*, Revised Statutes of Canada, 1985, Chapter S19. Completion of this questionnaire is a legal requirement under the Statistics Act.

Version française au verso

Information for the Respondent

Purpose of Survey

Statistics Canada is conducting this survey in order to develop information on biotechnology, and related technologies such as bioproducts as well as emerging technologies such as nanotechnologies by identifying industry sectors where these activities take place. Please report on *Canadian activities of your firm in biotechnology, nanotechnology or bioproducts*. Your firm may have responded to biotechnology questions in previous surveys, but there is also an increasing demand for information on other technologies and their impact on the Canadian economy.

Authority

Collected under the authority of the *Statistics Act*, *Revised Statutes of Canada*, 1985, Chapter S19. Completion of this questionnaire is a legal requirement under the *Statistics Act*.

Confidentiality

Statistics Canada is prohibited from publishing any statistics that would divulge information obtained from this survey that relates to any identifiable business, institution or individual. Data is treated in strict confidence, used for statistical purposes and released in aggregate form only. The confidentiality provisions of the *Statistics Act* are not affected by either the *Access to Information Act* or any other Legislation.

Federal-Provincial Agreement

In order to avoid duplication of enquiry, reduce the cost of collection, and provide consistent statistics, Statistics Canada has entered into an agreement with the Institut de la Statistique du Québec, under Section 11 of the *Statistics Act.* Data collected from Québec firms in this survey will be transmitted to the Institut de la Statistique du Québec. The *Statistics Act* of Quebec includes the same provisions for confidentiality and penalties for disclosure of information as the Federal *Statistics Act*.

Instruction

A knowledgeable senior person in your firm, such as an R&D manager or production manager, can quickly complete this questionnaire. Please fill in the contact information below, answer the first 4 questions as well as question 5 if applicable and return the completed questionnaire in the accompanying self addressed prepaid envelope to Statistics Canada by November 15, 2003.

Assistance

If you have questions or require assistance please contact:

Claire Racine-Lebel
Statistics Canada
7th floor, R.H. Coats Building, Tunney's Pasture
Ottawa, Ontario K1A 0T6

Telephone: 613-951-6309
Fax: 613-951-9920
E-mail: Sieidinfo@statcan.ca

Please provide the following information:

Name of person completing this form	Telephone number Area code | | | – | | | | – | | | | | | |
Title	Fax number | | | | – | | | | | | |
Web address	E-mail

5-5300-503: 2003-07-15 STC/SAT-465-75330

1. Does your firm currently use or develop biotechnology in its activities or strategies?

Definition of biotechnology

Biotechnology is defined as the application of science and engineering in the direct or indirect use of living organisms in their natural or modified forms in an innovative manner in the production of goods and services or to improve existing processes. Examples of biotechnologies are: DNA genomics, pharmaco-genetics gene probes, DNA sequencing/synthesis/amplification, genetic engineering. Protein/peptide sequencing/synthesis, lipid/protein engineering, proteomics, hormones and growth factors, cell receptors/signaling/pheromones, cell/tissue culture, tissue engineering, hybridization, cellular fusion, vaccine/immune stimulants, embryo manipulation, bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurization, bioremediation, biofiltration, gene therapy, viral vectors, bioinformatics, other.

○ Yes ○ No ▶ **Do you plan to use or develop biotechnologies within the next three years?**

○ Yes ○ No

2. Does your firm provide biotechnology related goods or services to other biotechnology firms or organizations?

○ Yes ○ No

3. Is your firm engaged in research and development of nanotechnologies?

Definition of nanotechnology

Nanotechnology is defined by the National Research Council (NRC) as "manufacturing at the molecular level - building things from molecular or nano-scale components. A nanometre is one billionth of a metre (3 - 4 atoms wide. Nanotechnology proposes the construction of novel nano-scale devices possessing extraordinary properties. Through the development of such instruments and techniques it is becoming possible to study and manipulate individual atoms".

○ Yes ○ No

4. Does your firm produce or develop any of the following bioproducts?

List of bioproducts

Bio-fuels ethanol, bio-diesel
Bio-energy heating and electricity
Bio-chemicals/bio-pharmaceuticals
Bio-plastics/bio-adhesives
Bio-lubricants/bio-solvents
Bio-catalysts
Bio-sensors
Bio-pesticides/bio-fungicides
Fiberboard/agri-fiber panels
Textiles from hemp and flax
Other bioproducts please specify

○ Yes ○ No

5. If you answered " yes " to at least one of the previous questions (questions 1, 2, 3 or 4), please provide the name of a contact person (the person can be you) that is the most qualified to answer questions related to the biotechnology, nanotechnology or bioproducts activities of your firm:

Name of this person _____

Title _____

Telephone number (Area code) ___ ___ – ___ ___ ___ ___

Fax number ___ ___ – ___ ___ ___ ___

E-mail _____

Comments

Thank you for your cooperation

Science, Innovation and Electronic Information Division

Biotechnology Use and Development Survey - 2003

Confidential when completed

Collected under the authority of the Statistics Act, Revised Statutes of Canada, 1985, c. S-19.
Completion of the questionnaire is a legal requirement under the Statistics Act.

Si vous préférez ce questionnaire en français, veuillez cocher ☐

Information for the Respondent

Purpose of Survey

Statistics Canada is conducting this survey to produce a profile of firms engaged in biotechnology activities in Canada. The survey focuses on the characteristics and activities of firms that use or develop biotechnology as part of their company's activity. It will also help us learn about the key characteristics of firms that develop or make bioproducts as part of the biotechnology sector.

Biotechnology is an emerging sector of the Canadian economy and its impact has the potential to be felt through all parts of Canada's society. An accurate understanding of biotechnology requires comprehensive data. Information from this survey may be used by businesses for economic or market analysis, by trade associations to study industry performance, government departments and agencies to assist policy formation, and by the academic community for research purposes.

Please report on year 2003 Canadian biotechnology and bioproducts activities of your firm unless a specific question indicates otherwise. Complete a separate questionnaire for each company engaged in biotechnology (or bioproducts) activities in Canada.

Planned Data Linkage

In order to enhance the analytic value of this survey, Statistics Canada intends to combine the data from this survey with the data you provided to the Survey of Innovation.

Authority

Collected under the authority of the *Statistics Act,* Revised Statutes of Canada, 1985, Chapter S-19. Completion of this questionnaire is a legal requirement under the *Statistics Act.*

Confidentiality

Statistics Canada is prohibited from publishing any statistics that would divulge information obtained from this survey that relates to any identifiable business, institution or individual. Data is treated in strict confidence, used for statistical purposes and released in aggregate form only. The confidentiality provisions of the *Statistics Act* are not affected by either the Access to Information Act or any other Legislation.

Federal-Provincial Agreement

In order to avoid duplication of enquiry, reduce the cost of collection and provide consistent statistics, Statistics Canada has entered into an agreement with the Institut de la Statistique du Québec. Under Section 11 of the Statistics Act data collected from Quebec firms in this survey will be transmitted to the Institut de la Statistique du Québec. The Statistics Act of Quebec includes the same provisions for confidentiality and penalties for disclosure of information as the Federal Statistics Act.

Who should complete this questionnaire?

A knowledgeable senior person in your firm, such as an R&D manager or production manager, can quickly complete this questionnaire.

Assistance

If you have questions or require assistance please contact:

Statistics Canada - Science, Innovation and Electronic Information Division
7th floor, R.H. Coats Building, Tunneys Pasture
Ottawa, Ontario K1A 0T6

Telephone: 1-866-334-3393
Fax: 1-888-869-0972
E-mail: sieidinfo@statcan.ca

Please provide the following information:

Name of person completing this form	Telephone number Area code | | | – | | | – | | | | | | |
Title	Fax number | | | – | | | | | | |
Web address	E-mail

5-5300-500.1: 2004-04-16 STC/SAT-465-75330

Section 1 - Biotechnologies in Use

This section measures the use of biotechnologies in your firm.

1. Using the table below, please indicate the use your firm makes of each type of biotechnology listed. Check the applicable circle or circles.

Biotechnologies	Currently Used in Operation	If currently using, do you use them for			Number of Years in Use
		Product/ Process Development	Current Production	Environmental Purposes	
					6
DNA - the coding					
e.g. Genomics/Pharmaco-genetics, Gene probes, DNA sequencing synthesis amplification, Genetic Engineering	1000 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Proteins and Molecules - the functional blocks					
e.g. Protein/peptide sequencing/synthesis, Lipid/protein engineering, Proteomics, Hormones, growth factors, pheromones, Cell receptors signalling	1100 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Cell and Tissue Culture, and Engineering					
e.g. Cell/ tissue culture, Embryo manipulation, Tissue engineering, Hybridization, Cellular fusion, Vaccine/immune stimulants	1200 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Process Biotechnologies					
e.g. Bioreactors, Fermentation, Bioprocessing, Bioleaching, Bio-pulping, Biobleaching, Biodesulphurization, Bioremediation, Biofiltration	1300 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Sub-Cellular Organisms					
e.g. Gene Therapy, Viral Vectors	1400 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Other					
Bioinformatics	1500 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Nanobiotechnologies	1600 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Environmental biotechnology	1700 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	
Other, Please Specify: _____	1800 1 ◯ Yes → 2 ◯ No	3 ◯	4 ◯	5 ◯	

If you use at least one of the biotechnologies listed in Question 1 ▶ **Go to Section 2**

If you do not use any of the biotechnologies listed in Question 1 ▶ **Go to Section 7 (bioproducts) and complete questions 25 to 30.**

Section 2 - Human Resources in Biotechnology

Concerns have been expressed about the availability of skilled biotechnology employees. Your cooperation in careful completion of this section is essential in developing an accurate understanding of human resources in biotechnology. For the purpose of this survey Employees are defined as those workers for whom you completed a Canada Revenue Agency T-4 statement for the 2003 tax year. Include working owners. Do not include students. Only count employees working in Canada. If '0' (zero) indicate '0'.

Number of Biotechnology Employees

2. a) How many employees does your firm employ in Canada?
Please report typical employment level for 2003. 2000 ____

b) How many employees have biotechnology-related responsibilities?
Please report typical employment level for 2003. 2010 ____

c) Employees with full-time biotechnology responsibilities
For each group listed below indicate how many are employees with full-time biotechnology related responsibilities (50% or more of their time spent on biotech related activities)?
If an employee fulfills more than 1 duty, report their primary responsibility.
Count each person only once. Please report typical employment level for 2003.

Position		Number of full-time
Scientific Research & Direction	2100	
Technicians	2110	
Regulatory/Clinical Affairs	2120	
Production	2130	
Finance/Marketing	2140	
Management	2150	
Other, Please Specify: _____	2160	
Total number of employees with full-time biotechnology responsibilities	2170	

d) Employees with part-time biotechnology responsibilities
For each group listed below indicate how many are employees with part-time biotechnology reponsibilities (less than 50% of their time spent on biotech related activities)?
If an employee fulfills more than 1 duty, report their primary responsibility.
Count each person only once. Please report typical employment level for 2003.

Position		Number of part-time
Scientific Research & Direction	2200	
Technicians	2210	
Regulatory/Clinical Affairs	2220	
Production	2230	
Finance/Marketing	2240	
Management	2250	
Other, Please Specify: _____	2260	
Total number of employees with part-time biotechnology responsibilities.	2270	

e) Total number of biotechnology employees.
Total employees with full-time and part-time biotechnology-related responsibilities (Box 2170 + Box 2270) 2011 ____

This number must equal 2010 above.

Recruiting Practices

3. a) Does your firm have unfilled biotechnology-related positions?

3000
2 ◯ No ▶ Go to question 3b)

1 ◯ Yes ▶ In the table below indicate the number of unfilled positions by category:

Position		Number of Unfilled Positions
Scientific Research & Direction	3100	
Technicians	3110	
Regulatory/Clinical Affairs	3120	
Production	3130	
Finance/Marketing	3140	
Management	3150	
Other, Please Specify: _____	3160	
Total unfilled positions	3170	

b) Did your firm attempt to recruit any biotechnology employees in 2003?

3200
2 ◯ No ▶ Go to question 5

1 ◯ Yes ▶ Were you successful?

3300 2 ◯ No ▶ Go to question 3c)

1 ◯ Yes ▶ How many did you hire? 3310 [ ]

c) Did you attempt to hire biotechnology staff from outside of Canada in 2003?

3400
2 ◯ No ▶ Go to question 4

1 ◯ Yes ▶ In the table below indicate the number of biotechnology staff you hired from each country/region:

Country/Region		Number of employees hired
USA	3410	
Europe	3420	
Asia	3430	
Other, Please Specify _____	3440	
Total employees hired from outside of Canada	3450	

4. Please rate the impact of the following factors on your efforts in filling biotechnology-related vacancies.

Factors		Importance Low 1	2	3	4	High 5
Candidate Factors						
Compensation requirements by candidates too high	4000	◯	◯	◯	◯	◯
Candidates unwilling to relocate	4010	◯	◯	◯	◯	◯
Lack of experience	4020	◯	◯	◯	◯	◯
Firm Factors						
Capital/resources insufficient to attract candidates	4100	◯	◯	◯	◯	◯
External Factors						
Lack of qualified candidates	4200	◯	◯	◯	◯	◯
Competition for qualified candidates	4210	◯	◯	◯	◯	◯
Other, Please Specify _____	4300	◯	◯	◯	◯	◯

5. Did any biotechnology personnel leave your firm in 2003?

5000 2 ◯ No ▶ Go to question 6

1 ◯ Yes ▶ How many? 5010 [ ]

Section 3 - Firm History

6. What year was your firm established?

6000 [ ]

7. Is your firm a public firm?

7000 2 ◯ No ▶ Go to question 8

1 ◯ Yes ▶ What year was the Initial Public Offering (IPO)? 7010 [ ]

8. Has your firm merged with another firm?

8000 2 ◯ No ▶ Go to question 9

1 ◯ Yes ▶ What year did the merge take place? 8010 [ ]

9. Is your firm a subsidiary of a Multi-National Enterprise (MNE)?

9000 2 ◯ No

1 ◯ Yes

10. Is your firm a spin-off? A spin-off is defined as a new firm created to transfer and commercialize inventions and technology developed in universities, firms or laboratories.

10000 2 ◯ No ▶ Go to question 11

1 ◯ Yes ▶ Was your firm a spin-off from 10010 ▶

- University/hospital 1 ☐
- Another Biotech company 2 ☐
- Non-biotech firm 3 ☐
- Government Agency/lab 4 ☐
- Other, Please Specify 5 ☐

_____

Section 4 - Biotechnology Products

This section measures the development of new biotechnology products and processes by your firm.

11. a) Do you have biotechnology products/processes on the market?

11000 2 ◯ No

1 ◯ Yes

b) Is your firm currently developing products that require the use of biotechnology?

11100 2 ◯ No

1 ◯ Yes

c) Is your firm currently developing processes that require the use of biotechnology?

11200 2 ◯ No

1 ◯ Yes

d) Do you consider biotechnology central to your firm's activities or strategies?

11300 2 ◯ No

1 ◯ Yes

If you answered "Yes" to any Part of Question 11 ▶ **Go to Q12**

Otherwise ▶ **Go to Section 7 (bioproducts) and complete questions 25 to 30.**

12. In the table below, for each sector listed please indicate the number of biotechnology products or processes your firm currently has for each stage of development.

Biotechnology Sector	Number of biotechnology products/processes by development stage			
	Research & Development 0	Pre-clinical trials/ Confined field trials 1	Regulatory phase/ Unconfined release assessment 2	Approved/ On market/In production 3
Human Health				
12000 **Diagnostics** (e.g. biosensors, immunodiagnostics, gene probes)				
12010 **Therapeutics** (e.g. vaccines, immune stimulants, biopharmaceuticals)				
12020 **Drug Delivery**				
Agriculture Biotechnology				
12100 **Plant Biotechnology** (e.g. tissue culture, embryogenesis, genetic markers, genetic engineering)				
12110 **Animal Biotechnology** (e.g. diagnostics, therapeutics, embryo transplantation, genetic markers, genetic engineering)				
12120 **Non-food Agriculture** (e.g. fuels, lubricants, commodity and fine chemical feedstocks, cosmetics)				
Natural Resources				
12200 **Energy** (e.g. microbiologically enhanced petroleum recovery, industrial bioprocessing, biodesulphurization)				
12210 **Mining** (e.g. microbiologically enhanced mineral recovery, industrial bioprocessing, biodesulphurization)				
12220 **Forest Products** (e.g. biopulping, biobleaching, biopesticides, tree biotechnology, industrial bioprocessing)				
Environment				
12300 **Air** (e.g. bioremediation, diagnostics, phytoremediation, biofiltration)				
12310 **Water** (e.g. biofiltration, diagnostics, bioremediation, phytoremediation)				
12320 **Soil** (e.g. biofiltration, diagnostics, bioremediation, phytoremediation)				
Aquaculture				
12400 **Fish health, broodstock genetics, bioextraction**				
Bioinformatics				
12500 **Genomics & molecular modelling** (e.g. DNA/RNA/protein synthesising & databases for humans, plants, animals, and micro-organisms)				
12510 **Gene therapy** (e.g. gene identification, gene constructs, gene delivery)				
Food Processing				
12600 **Bioprocessing** (e.g. using enzymes and bacteria culture)				
12610 **Functional Foods/Nutraceuticals** (e.g. probiotics, unsaturated fatty acids)				
Other, Please Specify 12700				

13. a) In 2003, did you have biotechnology products or processes in any stage of research and development (but not yet on market)?

13000
2 ◯ No ▶ Go to question 14

1 ◯ Yes ▶ Of the products or processes your firm had in research and development stages (not yet on market) in 2003, how many require formal regulatory evaluation and/or approval by Canadian inspection agencies? ▶ Number of products or processes 13010 [ ]

b) In 2003, for your **principal** product or process please indicate the current stage of development:

Research and development	13100	1 ◯
Preclinical	13110	2 ◯
Regulatory stage	13120	3 ◯

c) How long has your **principal** biotechnology product or process been under development?

Number of years ▶ 13200 [ ] Number of months ▶ 13201 [ ]

d) How much has your firm invested in research and development of this principal biotechnology product or process?

13300 $ [ ] ,000

14. a) In 2003, did you have biotechnology products or processes in production or on the market?

14000
2 ◯ No ▶ Go to question 15

1 ◯ Yes ▶ Of the products or processes your firm had on the market in 2003 how many were subject to formal regulatory evaluation and/or approval by Canadian inspection agencies? ▶ Number of products or processes 14010 [ ]

b) What was the **total time** required to bring your principal biotechnology product or process from the initial development phase/proof of concept stage to market?

Number of years ▶ 14100 [ ] Number of months ▶ 14101 [ ]

c) What was the **total cost** to bring your principal biotechnology product or process from the initial development phase/proof of concept stage to market?

14200 $ [ ] ,000

Section 5 - Business Practices

Contracting Out

15. a) Did your firm contract out biotechnology related activities in 2003?

15000 2 ◯ No ▶ Go to question 15d)

1 ◯ Yes ▶ For each partner type listed below, please indicate the number and value of contracts for each group listed.

Contract Type	Number of Contracts	Total Value of Contract in 2003 by purpose: ($,000)			
		R&D	Regulatory/ clinical	Management/ Production	Other
	0	1	2	3	4
15100 Private research lab		$,000	$,000	$,000	$,000
15110 University/Hospital		$,000	$,000	$,000	$,000
15120 Government Lab		$,000	$,000	$,000	$,000
15130 Other biotech firm		$,000	$,000	$,000	$,000
15140 Other, Please Specify _____		$,000	$,000	$,000	$,000

b) Did contracting out in 2003 replace biotechnology employees in your firm?

15200 2 ◯ No ▶ Go to question 15c)

1 ◯ Yes ▶ Please indicate the number of employees replaced for each group listed below.

Position		Number of employees replaced
Scientific Research & Direction	15210	
Technicians	15220	
Regulatory/Clinical Affairs	15230	
Production	15240	
Finance/Marketing	15250	
Management	15260	
Other, Please Specify: _____	15270	
Total number of employees replaced by contracting out activities	15280	

c) Rate the level of importance of each of the following reasons on your decision to contract out.

Reasons for Contracting Out		Importance Low 1	2	3	4	High 5
Knowledge not available internally	15300	◯	◯	◯	◯	◯
Access outside scientific expertise	15310	◯	◯	◯	◯	◯
Cost Reduction Related to:						
R&D Activities	15320	◯	◯	◯	◯	◯
Regulatory/Clinical Affairs	15330	◯	◯	◯	◯	◯
Production	15340	◯	◯	◯	◯	◯
Reduce risk/exposure	15350	◯	◯	◯	◯	◯
Other, Please Specify: _____	15360	◯	◯	◯	◯	◯

d) Does your firm **provide** contract services to other firms or organizations?

15400 2 ◯ No ▶ Go to question 16

1 ◯ Yes ▶ For each type of contract services listed below, please indicate the number of contracts entered into in 2003 and the revenues received from each:

Contract Services	Number of contracts entered into in 2003 (0)	Revenues received from this source in 2003 (1)
15500 Private reseach lab		$,000
15510 University/Hospital		$,000
15520 Government lab		$,000
15530 Other biotechnology firm		$,000
Other, Please Specify: 15540 _____		$,000
Total 15550		$,000

Collaborative Arrangements

Cooperative and collaborative arrangements involve the active participation in projects between your company and other companies or organizations in order to develop and/or continue work on new or significantly improved biotechnology processes, products and/or services. **Pure contracting-out work is not regarded as collaboration.**

16. a) Was your firm involved in biotechnology-related cooperative/collaborative arrangements with other companies or organizations in 2003?

16000 2 ◯ No ▶ Go to question 17

1 ◯ Yes ▶ Provide the number of arrangements by purpose and partner type:

Arrangement Purpose	**Number of Arrangements by Partner Type**			
	Biotech Firm (0)	Non-biotech Firm (1)	Academic Institution/ Hospital (2)	Government lab or agency (3)
16100 Knowledge not available internally				
16110 Access outside scientific expertise				
Cost reduction related to:				
16120 R&D activities				
16130 Regulatory/Clinical affairs				
16140 Production				
16150 Precursor to a formal agreement				
16160 Reduce risk/exposure				
Other, Please Specify 16170 _____				
Total number of arrangements 16180				

Collaborations with foreign partners

16. b) In 2003, was your firm involved in biotechnology related cooperative/collaborative arrangements with other **foreign** companies or organizations?

16200
2 ◯ No ▶ Go to question 17

1 ◯ Yes ▶ In the table below, check collaboration/cooperation arrangements by each type and their geographic location:

Country/Region		Partner Type				
		Biotechnology Firm	Non-biotechnology Firm	Academic Institution/ Hospital	Government lab or agency	Other
USA	16210	1 ◯	2 ◯	3 ◯	4 ◯	5 ◯
Europe	16220	1 ◯	2 ◯	3 ◯	4 ◯	5 ◯
Asia	16230	1 ◯	2 ◯	3 ◯	4 ◯	5 ◯
Other, Please Specify _____	16240	1 ◯	2 ◯	3 ◯	4 ◯	5 ◯

Reasons for allying with foreign partners

c) Rate the following purposes in your decision to form a collaborative/cooperative arrangement with a **foreign partner** (located outside of Canada):

Arrangement Purpose		Importance Low 1	2	3	4	High 5
Knowledge not available internally	16300	◯	◯	◯	◯	◯
Access outside scientific expertise	16310	◯	◯	◯	◯	◯
Cost reduction related to:						
R&D activities	16320	◯	◯	◯	◯	◯
Regulatory/Clinical affairs	16330	◯	◯	◯	◯	◯
Production	16340	◯	◯	◯	◯	◯
Precursor to a formal agreement	16350	◯	◯	◯	◯	◯
Reduce risk/exposure	16360	◯	◯	◯	◯	◯
Other, Please Specify _____	16370	◯	◯	◯	◯	◯

Intellectual Property

17. a) Does your firm have biotechnology related patents or pending patents?

17000
2 ◯ No ▶ Go to question 18

1 ◯ Yes ▶ How many?

Indicate the distribution of biotechnology related patents and pending patents your firm has by patent office:

		Canadian Intellectual Property Office (CIPO) 0	U.S. Patent & Trademark Office (USPTO) 1	European Patent Office 2	Other 3
Existing Patents	17100				
Pending Patents	17110				

b) Provide the number of unique patent applications your company submitted in:

		Number
Year 2002	17200	
Year 2003	17210	

18. a) Did your firm **grant** biotechnology related intellectual property (IP) rights to another firm?

18000 2 ◯ No ▶ Go to question 18b)

1 ◯ Yes ▶ For each type of intellectual property instrument listed below please indicate the number of IP rights granted by country and the total income received from IP licensing in 2003.

Intellectual Property Instrument	Number with Canadian firms 0	Number with USA firms 1	Number with other country firms 2	Revenue from IP licensing in 2003 3
18100 Licensing Agreement				$,000
18110 Patent assignment				$,000
18120 Technology Transfer Agreement				$,000
18130 Other, Please Specify _____				$,000

b) Did your firm **obtain** biotechnology related intellectual property rights from another firm?

18200 2 ◯ No ▶ Go to question 19

1 ◯ Yes ▶ Complete the following table:

Intellectual Property Instrument	Number with Canadian firms 0	Number with USA firms 1	Number with other country firms 2	Cost to your firm of obtaining IP in 2003 3
18300 Licensing Agreement				$,000
18310 Patent assignment				$,000
18320 Technology Transfer Agreement				$,000
18330 Other, Please Specify _____				$,000

Section 6 - Firm Characteristics and Financial Profile

Revenues and Research and Development (R&D) Expenditures

19. Please complete the following table. If information is not available please provide a carefully considered estimate. Report for fiscal years and in thousands of dollars ($,000's). If '0' (ZERO) please indicate, do not leave blanks.

	2002 0	2003 1	2005 Forecast 2
19000 Total Firm Revenues (all sources)	$,000	$,000	$,000
19010 % of revenues from Biotechnology	%	%	%
19020 Total R&D spending	$,000	$,000	$,000
19030 Total spending on Biotechnology R&D	$,000	$,000	$,000
19040 % of Biotechnology R&D spending contracted out	%	%	%

Raising Capital

A great deal of attention has focused on the ability of biotechnology firms to raise capital and the challenges of raising capital. Questions in this section are intended to collect information in order to address this critical issue facing the biotechnology sector.

20. a) Did your firm **attempt** to raise capital for biotechnology related purposes in 2003?

20000
2 ◯ No ▶ Go to question 20f)

1 ◯ Yes ▶ Why did you attempt to raise capital? Indicate each category that applies to your firm:

20010 1 ◯ R&D purposes/Expand R&D capacity

20020 2 ◯ Repay current investors

20030 3 ◯ Commercialize current R&D projects

20040 4 ◯ Clinical/regulatory expenses

20050 5 ◯ Develop production/manufacturing capability

20060 6 ◯ Other, Please Specify:

_____

b) Were you successful in raising capital?

20100
2 ◯ No ▶ Go to question 20d)

1 ◯ Yes ▶ How much capital did you raise in 2003? ▶ 20110 $,000

c) Did you reach your target?

20200
2 ◯ No ▶ Go to question 20d)

1 ◯ Yes ▶ Go to question 20e)

d) What reasons did the **lender** give in limiting or refusing your request for capital? Check all that apply.

Biotechnology product/process not sufficiently developed	20310 1	☐
Biotechnology product line or portfolio limited in scope	20320 2	☐
Insufficient specific management skills/expertise	20330 3	☐
Capital not available due to market conditions	20340 4	☐
Further product development or proof of concept required	20350 5	☐
Lender does not fund development projects	20360 6	☐
Other, Please Specify	20370 7	☐

_____

e) What sources provided funding?

		% of total raised from each source?
Canadian based Venture Capital	20400	%
American based Venture Capital	20410	%
Conventional sources (i.e. banks)	20420	%
Angel Investors/Family	20430	%
Government sources	20440	%
Private placement	20450	%
IPO (Initial Public Offering)	20460	%
SPO (Secondary Public Offering)	20470	%
Collaborative arrangements, alliances	20480	%
Other, Please Specify _____	20490	%

20. f) Do you plan on raising capital in 2004?

20600
2 ◯ No ▶ Go to question 21

1 ◯ Yes ▶ How much do you plan to raise? ▶ 20610

< $1,000,000	1 ☐
$1,000,000-$5,000,000	2 ☐
> $5,000,000	3 ☐

Tax Incentives

21. a) In the past 5 years did your firm apply for benefits for biotechnology related activities under the Scientific Research and Experimental Development (SR&ED) tax program?

21000
1 ◯ Yes ▶
- How much did you apply for in 2003? 21010 $,000
- How much did you receive in 2003? 21020 $,000 ▶ Go to question 21b)

2 ◯ No ▶ Why?

Complexity of application process	21110 1 ☐
Uncertainty of eligibility	21120 2 ☐
Did not meet eligibility requirements	21130 3 ☐
Other, Please Specify:	21140 4 ☐

_____

b) Have any of your SR&ED credits expired?

21200
2 ◯ No

1 ◯ Yes

22. Did your firm apply for any provincial R&D tax benefit or incentive?

22000
1 ◯ Yes

2 ◯ No ▶ Why did you not apply?

Complexity of application process	22010 1 ☐
Uncertainty of eligibility	22020 2 ☐
Did not meet eligibility requirements	22030 3 ☐
Other, Please Specify	22040 4 ☐

_____

Imports & Exports

23. Did your firm export biotechnology products?

23000
2 ◯ No ▶ Go to question 24

1 ◯ Yes ▶ Please complete the following table. Report for fiscal years and in thousands of dollars ($,000's). If '0' (ZERO) please indicate, do not leave blanks.

	2002 (0)	2003 (1)	Forecast for 2005 (2)
23100 Total Exports Revenues (all sources)	$,000	$,000	$,000
23110 % export revenues from Biotechnology	%	%	%
Regional Distribution			
23200 % export revenues to US	%	%	%
23210 % export revenues to Europe	%	%	%
23220 % export revenues to Asia	%	%	%
23230 % export revenues to other regions	%	%	%

24. Did your firm import biotechnology products?

24000
2 ◯ No ▶ Go to question 25

1 ◯ Yes ▶ Please complete the following table. Report for fiscal years and in thousands of dollars ($,000's). If '0' (ZERO) please indicate, do not leave blanks.

		2002 0	2003 1	Forecast for 2005 2
Total Import Expenditures (all sources)	24100	$,000	$,000	$,000
% import expenditures from Biotechnology	24110	%	%	%
Regional Distribution				
% import expenditures to US	24200	%	%	%
% import expenditures to Europe	24210	%	%	%
% import expenditures to Asia	24220	%	%	%
% import expenditures to other regions	24230	%	%	%

Section 7 - Bioproducts

A bioproduct is defined as "a commercial or industrial product (other than food or feed) made with biological or renewable domestic agricultural (plant, animal) marine or forestry materials, such as, bio-energy (heating and electricity), bio-fuels (ethanol and bio-diesel), bio-chemicals, fiberboard, textiles, bio-plastics and other biomaterials".

25. Does your firm currently make or develop any bioproduct?
(Refer to the table below for examples of bioproducts).

25000
2 ◯ No ▶ Go to question 29

1 ◯ Yes ▶ In the table below, indicate the number of bioproducts your firm currently has for each stage of development.

Bioproducts		**Number of bioproducts by development stage**		
		R&D 0	Proof of concept/product development 1	Approval/ In production/ On market 2
Bio-fuels (ethanol, bio-diesel)	25100			
Bio-energy (heating and electricity)	25110			
Bioprocessing-based bioproducts (using enzymes and bacteria)	25120			
Bio-pharmaceuticals/bio-sensors/ biocatalysts/biochemicals	25130			
Bio-plastics	25140			
Biopesticides/biofungicides/bio-herbicides	25150			
Fiberboard/Agri-fiber panels	25160			
Other bioproducts or biomaterials, Please specify _____	25170			

Current Use of Renewable or sustainable feedstock/materials

26. Does your firm use any feedstocks/materials from the following list to develop or make bioproducts?

26000

2 ◯ No ▶ Go to question 27

1 ◯ Yes ▶ In the table below, indicate the renewable or sustainable feedstocks/materials used by your firm. Please check all that apply.

Biomass crops and trees / crop residues	26010	1 ◯
Forestry products/slash and mill waste	26020	2 ◯
Marine and aquaculture materials/products	26030	3 ◯
Animal products/waste/manure	26040	4 ◯
Industrial waste	26050	5 ◯
Municipal waste	26060	6 ◯
Other sustainable/renewable materials (Please specify) _____	26070	7 ◯

Financial Profile

27. Please complete the following table. If information is not available, please provide a carefully considered estimate. Report for fiscal years and in tousands of dollars ($, 000's). If "0" (ZERO) please indicate "0", do not leave blanks.

		2002 0	2003 1	2005 Forecast 2
Total firm revenues (all sources)	27000	$,000	$,000	$,000
% of total revenues from bioproducts	27010	%	%	%
Revenues derived from bioproduct exports	27020	$,000	$,000	$,000
Total Import expenditures from bioproducts	27030	$,000	$,000	$,000
Total R&D expenditures on bioproduct development	27040	$,000	$,000	$,000

Human Resources in Bioproducts Development

28. Please complete the table below. For the purpose of this question, Employees are defined as those workers for whom you completed a Canada Revenue Agency T-4 statement for the 2003 tax year. Include working owners. Do not include students. Only count employees working in Canada. If "0" (ZERO) indicate "0". **If an employee fulfills more than 1 duty, report their primary responsibility. Count each person only once**. Please report typical employment level for 2003.

		Number of employees in 2003
Total number of employees (in Canada)	28000	
Total number of employees with bioproducts-related activities. (Includes scientific research and direction, technicians, regulatory/clinical affairs, production, finance/marketing, management activities, etc.)	28010	
Total number of full-time employees with bioproducts-related activities (50% or more of their time spent on bioproducts-related activities)	28020	
Total number of part-time employees with bioproducts-related activities (less than 50% of their time spent on bioproducts-related activities)	28030	

Strategies Used in 2003

29. In the table below rate the significance of each of the following strategies on your firm's performance in 2003.

		Importance				
		Low				High
		1	2	3	4	5
Knowledge development strategies						
Captured and used knowledge obtained from other industry sources such as industry associations, competitors, clients and suppliers	29000	◯	◯	◯	◯	◯
Captured and used knowledge obtained from public research institutions including universities and government laboratories	29010	◯	◯	◯	◯	◯
Used and updated databases of scientific information	29020	◯	◯	◯	◯	◯
Developed firm policies and practices for knowledge/intellectual property protection	29030	◯	◯	◯	◯	◯
Developed/encouraged staff education/upgrading	29040	◯	◯	◯	◯	◯
Conducted an Intellectual Property Audit to ensure protection of products and processes at all stages of development	29050	◯	◯	◯	◯	◯
Business strategies						
Increased firm size through acquisition, merger or joint venture	29100	◯	◯	◯	◯	◯
Downsized operations of the firm	29110	◯	◯	◯	◯	◯
Entered product trials/adapted products or processes for increased market penetration	29120	◯	◯	◯	◯	◯
Began new research & development project	29130	◯	◯	◯	◯	◯
Expanded into foreign markets	29140	◯	◯	◯	◯	◯
Other, Please Specify: _____	29200	◯	◯	◯	◯	◯

30. Approximately, how many hours did you spend collecting the data and completing this questionnaire?

Hours ▶ 30000 ☐

Comments

Thank you for your assistance.

Return the questionnaire in the accompanying self addressed prepaid envelope.

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