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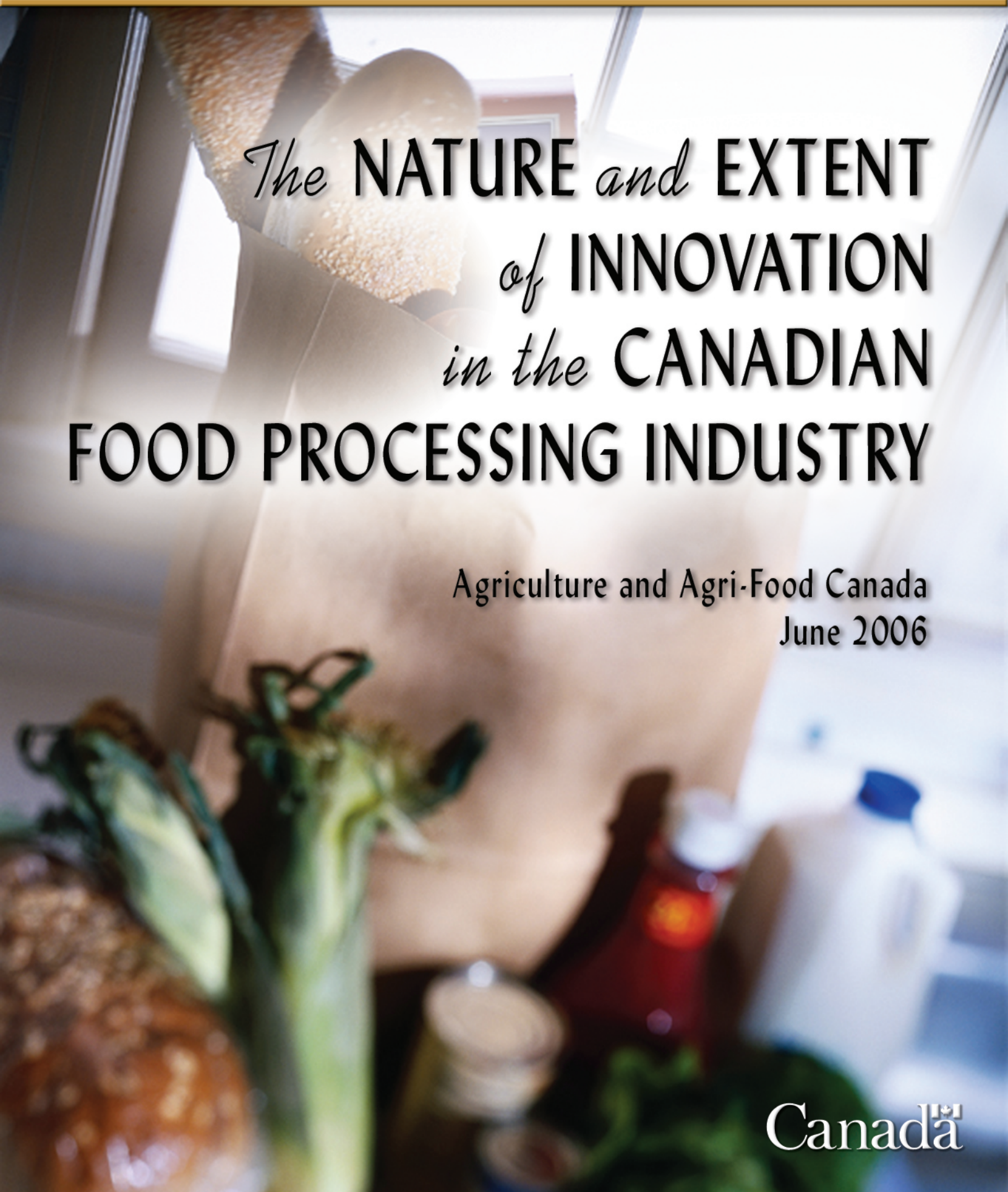

The NATURE and EXTENT of INNOVATION in the CANADIAN FOOD PROCESSING INDUSTRY

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The Nature and Extent of Innovation in the Canadian Food Processing Industry

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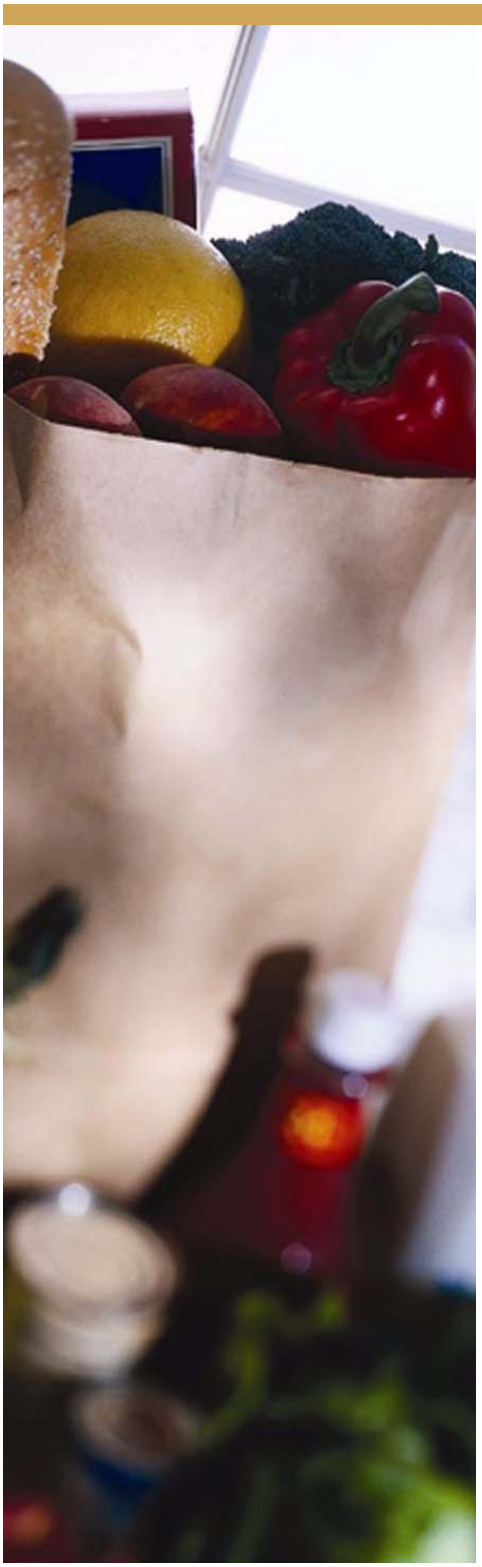

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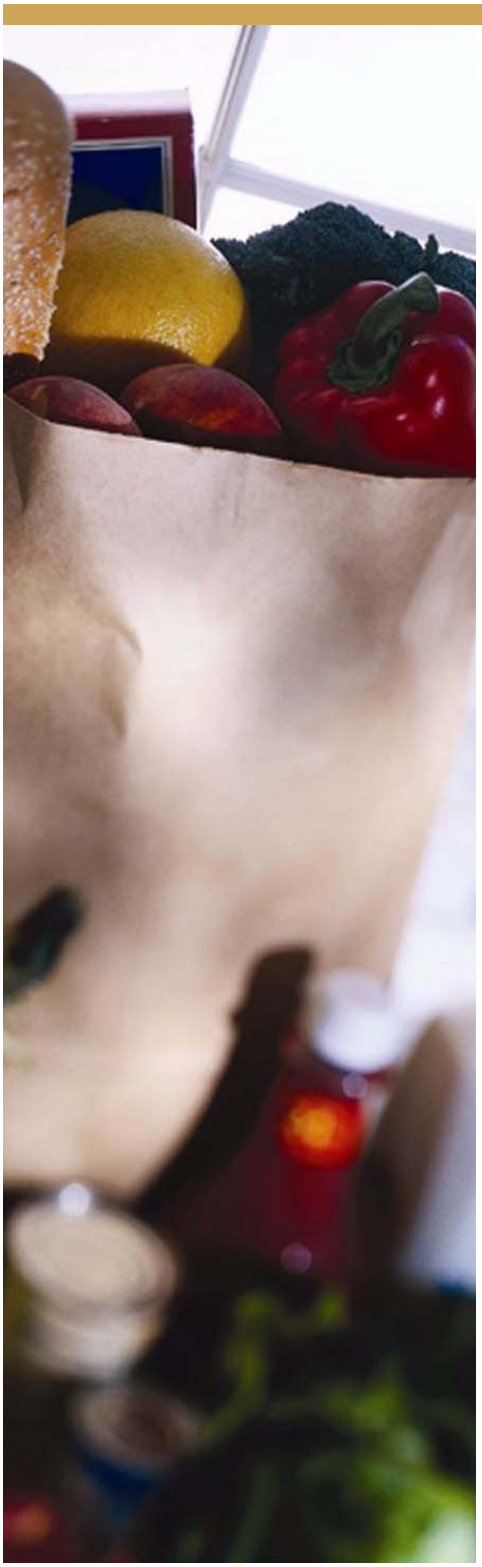

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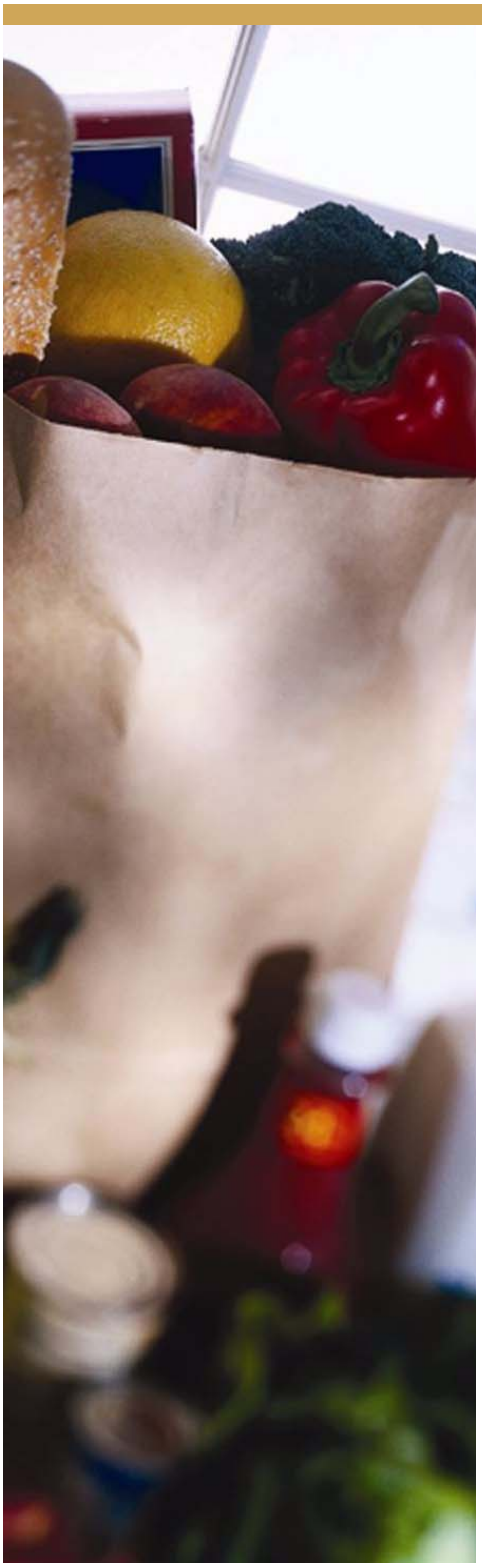

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Foreword

The agri-food chain today is significantly different from that of twenty years ago. Changing consumer demands, knowledge-intensive technology, North American integration and globalization have all contributed to the evolution of the different segments of the chain. The ability of a firm to compete both domestically and internationally depends very much on the firm's ability to produce what consumers want and at reasonable prices. This requires new or unique products, new and creative approaches to production and marketing.

Innovation is considered one of the critical determinants for improved competitiveness and economic performance of the food processing industry, if Canada is to meet the challenges of the rapidly changing global food market and to exploit niche markets for products and remain competitive in the long run. However, innovation is costly and risky and therefore requires an environment of collaboration between businesses, the financial community, research institutions and government.

The purpose of this report is to better understand the nature and extent of innovation, drivers behind its implementation, the challenges facing innovating establishments and the significance of support services. This report, which analyses data from the "Innovation in the Food Processing Industry Survey", will provide useful benchmark information for innovation activities in the food processing industry. The survey was conducted by Statistics Canada in 2004, on behalf of Agriculture and Agri-food Canada.

Private and public policy makers can use results from this study to identify effective strategies for research and development (R&D) and innovation in the agri-food value chain to meet the challenges of the dynamic global food market.

Executive summary

This report, which is based on the 2004 Innovation in Food Processing Industry Survey, provides an analysis of innovation in the food processing industry with a view to further understand the innovation process and to provide benchmark information for future comparisons about the nature and extent of creative innovation in the industry.

The Innovation in Food Processing Survey was conducted by Statistics Canada in 2004 on behalf of Agriculture and Agri-Food Canada (AAFC) with the main purpose of collecting statistical information on the nature and extent of creative innovation in the Canadian food processing industry. The survey covers activities of establishments for the period of 2001 to 2003.

The survey targeted all food processing establishments in Canada with annual revenue of at least $1 million in 2004 and had 43% response rate. It solicited information about the general industry characteristics, the competitive environment, R&D activities, creative innovation activities, obstacles to innovation, support activities for creative innovation and restructuring business relationships.

In the survey, innovation is defined as the introduction of any good, technology or service whose fundamental characteristics or intended uses are new or differ significantly from other products, technologies or services produced by the industry in North America. Research is defined as original investigation undertaken on a systematic basis by means of experiments and/or analysis to gain knowledge and development is defined as the application of research findings or other scientific knowledge for the creation of new products and processes.

The characteristics of establishments affect the ability to undertake R&D and innovate. Analysis of the data shows that food processing establishments vary by size. About 52% of food processing establishments are small with less than 50 employees. However, more than 50% of output is produced by the largest 5% of establishments. Size also varies by sub-sectors. Poultry processing, sugar and confectionery, and fruits, vegetable and specialty food have a relatively greater percentage of larger establishments whereas animal food, grain and oilseed milling, and bakeries and tortilla industries are dominated by many small establishments.

Food processing includes the processing of raw agricultural products, semi-prepared food products for use in further processing and food products for end-users. Approximately 58% of establishments in the survey focused on the processing of food products for end-users, 30% on

primary processing of raw agricultural products and another 12% on semi-prepared food products for use in further processing. The stages in the value chain where an establishment's activities are concentrated may influence the decision of an establishment to innovate. Establishments that process products for end-users are more likely to invest in R&D and innovation than establishments that are engaged in primary processing.

Country of ownership of an establishment also has implications for innovation. food processing establishments in the survey vary by country of ownership. About 87% of establishments have majority Canadian ownership. However, the few foreign controlled establishments account for a significant amount of output. Cargill and Lakeside Packers, for example, account for approximately 70% of beef production in Canada. Generally, larger-sized establishments are more likely to be foreign controlled. Foreign-controlled establishments are more likely to be found in grains and oilseed, and sugar and confectionery product industries. Establishments in poultry processing, meat products, dairy products, bakeries and tortillas and animal food industries are more likely to be domestically controlled.

The survey indicates that the tendency of establishments to conduct R&D or innovate may be influenced by their characteristics. Larger-sized and foreign-controlled establishments are more likely to undertake R&D and innovate than smaller-sized establishments, which tend to be Canadian controlled. This is either because larger-sized and foreign controlled establishments have the necessary resources to cover the cost of innovation, have better access to financing, and benefit from economies of scale and scope in innovation.

The competitive environment or the business environment has implication for a firm's incentive to innovate. A conducive business environment reduces business risk and encourages establishments to invest in R&D and innovation. There are several factors that may determine the competitive environment and affect the ability of food processing establishments to compete in both the domestic and international markets. The responses to the survey indicate that, Canadian food processing establishments consider the increased value of the Canadian dollar, consolidation of food retailers and wholesalers and the availability of competitively-priced raw agricultural products for processing as the top three most important factors impacting their ability to compete. Establishments in trade-oriented industries such as seafood product preparation and packaging, meat products, poultry processing, sugar and confectionery, and fruit, vegetable and specialty food are more likely to perceive the increased value of the Canadian dollar as a major impediment to competitiveness than domestically-focused industries. The availability of competitively-priced raw agricultural product for processing is perceived as the most important factor impeding competitive ability by establishments in the grain and oilseed milling industry.

The survey solicited information on R&D activities, as it is a major input into innovation. The survey shows that less than half of food processing establishments are engaged in R&D activities in Canada. A larger proportion of these establishments are engaged more in prototyping and scale-ups than in laboratory-based R&D activities. However, it is possible that those establishments that are not conducting or commissioning R&D are benefiting from R&D activities of their parent companies. The survey responses indicate that 43% of food processing establishments in Canada have parent companies with production and R&D units in Canada and other countries.

When Canadian food processing establishments were asked why they innovate, the following objectives were given:

- *To introduce new products to the existing lines of products,*

- *To increase market share,*
- *To meet buyers' standards or requirements, and*
- *To improve productivity or reduce production costs.*

In terms of incidence of innovation, the survey shows that 37% of establishments in the food processing industry are engaged in product innovation and 23% in process innovations. food processing establishments that are engaged in product innovation are more likely to develop completely new products using laboratory-based R&D investigation in establishments. Those who are engaged in process innovation are more likely to significantly adapt, improve or modify existing equipment, technology and systems through collaboration with packaging and equipment suppliers.

The incentive to innovate is strengthened if establishments can have intellectual property rights protection for their innovation. The survey found that Canadian food processing establishments use several methods to protect their innovations. These include registration of industrial design, trademark, patent, confidentiality agreement or trade secrets, copyright, lead-time advantage on competitors, and bundling with other products or services. Fast mover strategies such as trade secrets and lead-time advantage are more popular among Canadian food processing establishments than patents, registration of industrial design and copyright in protecting innovations. Patenting, which is sometimes used as indicator of innovation, is not a preferred method that is used by food processing establishments for protecting intellectual property. Only a few Canadian food processing establishments have reported applying for patents for their innovations.

The survey also solicited information on impediments to innovation. The responses indicate that raising capital internally is the greatest impediment to innovation. The factor which was reported as the least likely to impede innovation is difficulty in negotiating intellectual property rights. Other impediments that are reported include, in order of importance:

- *long gestation period of innovation,*
- *insufficient flexibility in regulations or standards,*
- *shortage of skilled workers,*
- *lack of marketing capability,*
- *lack of retail acceptance or access to distribution channels,*
- *lack of external equity funding,*
- *lack of debt financing,*
- *corporate or management resistance to innovation, and*
- *lack of idea champions.*

To overcome some of the obstacles, the majority of establishments in the food processing industry collaborate with food ingredient suppliers, equipment suppliers and packaging suppliers to develop new products and new processes. However, few food processing establishments collaborate with private and public research institutions in the innovation process. Except for R&D tax credits and to some extent R&D grants, government programs which support innovation are

used by a small number of establishments in the food processing industry. About 70% and 43% of food processing establishments reported using R&D tax credits and R&D grants, respectively, between 2001 and 2003. Larger-sized and foreign controlled establishments are more likely to use R&D tax credits and smaller-sized establishment are more likely to use R&D grants.

With increased globalization, competitive pressures on the food processing industry have become intense. R&D and innovation are considered critical to maintain and improve competitiveness. According to this study, only a small proportion of food processing establishments reported undertaking R&D and innovation. However, this does not necessarily imply lower competitiveness of the industry. R&D and innovation may be conducted at the headquarters of parent companies in Canada or multinationals. Studies show that there are potential spillovers from R&D and innovation conducted elsewhere for firms in Canada.

Section 1

Introduction

Canada's competitive advantage continues to decline. According to the 2003-2004 Global Competitiveness Report, Canada's overall ranking in current competitiveness index dropped from sixth place in 1998 to twelfth place among 102 countries in 2003 (World Economic Forum, 2003). In terms of company operations and strategy, Canada ranked fourteenth. The national business environment is also not as conducive to competitiveness as in other countries, with Canada ranking tenth in quality of national business environment. This along with findings from other Canadian reports (Conference Board of Canada, 2002; Manufacturers and Exporters, 2001) has raised serious concerns about Canada's ability to compete in the world market.

With increased globalization, competition has become intense for individual firms. Consumers have also become more sophisticated and have shifted consumption patterns from mere commodities to commodities with credence attributes such as food safety and quality. The ability of a firm to compete both domestically and internationally depends very much on the firm's ability to produce what consumers want and at a reasonable price. This requires new and creative approaches to production.

Innovation is considered one of the critical determinants for improved competitiveness and economic performance. Product innovation, in particular, is considered a key competitive strategy in the food processing industry. David Landes (1969) did not exaggerate in the late 1960s when he linked the industrial revolution to financial and technological advances. Countries that show more evidence of innovation are richer and grow faster and companies that show more evidence of innovation post better financial performance and have higher share prices (Morck and Yeung, 2001). Morck and Yeung (2001) further emphasise that in a knowledge-based economy, the primary competition is competition to innovate first, not competition to cut prices as standard economics posits.

Canada recognises the importance of innovation and research and development for competitiveness and has shown a high level of commitment to innovation through several initiatives. In the 2001 speech from the throne, a commitment was made by the Canadian government to double federal investments in research and development by 2010 with the main goal of making Canada one of the top five competitive countries in the world. A 2002 paper by Industry Canada on inno-

vation strategy set some goals for achieving competitiveness through innovative products, processes and services. Agriculture and Agri-food Canada (AAFC) has also identified science and innovation as one of the key elements of the Agricultural Policy Framework (APF) in ensuring sustained growth and profitability in the agriculture and agri-food sector.

Understanding the nature and extent of innovation is critical for the development of effective strategies to achieve the goals set out by the government and in the APF. However, not much is known currently about the extent of innovation in the Canadian food processing industry. The 1998 Survey on Advanced Technology in the Canadian food processing industry showed that foreign-controlled plants use advanced technologies with a much higher frequency than Canadian plants. The survey also concluded that over 60% of food processing firms in Canada stressed the importance of introducing new products or penetrating new markets and between 1995 and 1997, about 50% of processing plants made at least one major product innovation that did not involve a process change. The 1999 survey of innovation conducted by Statistics Canada also revealed that, in the 1997-1999 period, some 73.5% of all firms in the food processing sector reported one or more product innovations. This survey, however, was based on a broad definition of innovation[1].

This report analyses data from the 2004 Innovation in the Food Processing Survey. AAFC commissioned Statistics Canada to conduct this survey with the aim of providing some basic and current information on innovation in the food processing industry, to further understand the innovation process in the industry, and for benchmarking.

The main purpose of this report is therefore to provide information about the nature and extent of creative innovation in the Canadian food processing industry. The specific objectives of this report are:

- *To assess the nature and extent of product and process innovations in the Canadian food processing industry;*
- *To investigate the nature and level of research and development (R&D) activities in the Canadian food processing industry;*
- *To evaluate the obstacles to innovation in the food processing industry;*
- *To determine the extent of collaboration among various stakeholders for innovation in the food processing industry; and*
- *To examine the use and importance of government programs and services for innovation.*

The organization of this report is as follows: the next section provides an overview of the structure and performance of the Canadian food processing industry. The survey and methodology are presented in Section 3. The characteristics of establishments in the Innovation Survey are discussed in Section 4 with Section 5 addressing the competitive environment of the food processing industry. The degree and level of R&D is discussed in Section 6. The extent and nature of innovation in the food processing industry is assessed in Section 7. Obstacles to innovation in the industry are examined in Section 8. Section 9 addresses collaboration in innovation while government support activities for R&D and innovation are discussed in Section 10. The summary and conclusions are given in Section 11.

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1. In the 1999 Innovation Survey, innovation is defined as any new product/manufacturing process that is new to the firm.

Section 2

Background of the Canadian food processing industry

Innovation is just one of the many strategies adopted by businesses to gain a competitive edge. Innovation and other business strategies are influenced by industry structure and performance. The structure of a given industry may limit or enhance innovative activities whereas performance provides an impetus for innovation. Analysis of the structure and performance of an industry will provide a better understanding of why some establishments innovate and others don not. This section therefore provides an overview of the structure and performance of the food processing industry.

Growth of the industry

With a real gross domestic product (GDP) of $17 billion in 2004, the food processing industry is the third most important manufacturing industry in Canada accounting for about 1.7% of total GDP and almost 10% of total manufacturing GDP (Table 1). The industry's significance in the Canadian economy has, however, declined over time, a trend that extends from the 1980s. A decade ago, food processing accounted for 11% of manufacturing GDP and 1.8% of total GDP and two decades ago, it accounted for 14% of total manufacturing GDP.

Table 1: Gross domestic product, Canada, 1992-2004 (Constant 1997 $)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Billion $)												
All industries	703	721	753	773	784	817	849	897	946	961	993	1,016	1,049
Total manufacturing	111	117	126	132	134	142	149	162	180	171	174	174	181
Food processing	13	13	14	14	14	14	15	15	16	17	17	17	17
Food (% of all industries)	1.9	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.7	1.7	1.6	1.7
Food (% of manufact.)	12.0	11.4	10.9	10.5	10.3	9.7	9.8	9.3	8.7	9.7	9.7	9.6	9.7

Source: Statistics Canada, CANSIM Table 379-0017.

The industry's real output and productivity are also increasing at a slower rate compared to all manufacturing. As indicated in Table 2, the real output in the food processing industry grew at a rate of 2.6% per year compared to 4% for total manufacturing between 1990 and 2002. Although, the real output growth for the food processing industry of 3.6% per year between 1996 and 2002 is greater than the 1.6% per year rate in the early part of the 1990s, it is still slower than the average of 5.1% per year for total manufacturing.

Table 2: Productivity growth in total manufacturing and the food processing industry, 1990-2002

	1990	1995	Avg. annual growth rate 1990-1995 (%)	1996	2002	Avg. annual growth rate 1996-2002 (%)	Avg. annual growth rate 1990-2002 (%)
Real GDP				(Billion $ in 1997 prices)			
Total manufacturing	117.6	132.1	2.5%	133.6	174	5.1%	4.0%
Food processing	12.8	13.9	1.6%	13.8	16.8	3.6%	2.6%
Total employment				(Thousand)			
Total manufacturing	1,814.4	1,667.5	-1.3%	1,728.9	1,958.9	2.2%	0.7%
Food processing	203.4	192.9	0.9%	198.9	243.8	3.8%	1.7%
Production workers				(Thousand)			
Total manufacturing	1,378.7	1,276.9	-1.5%	1,339.7	1,528.7	2.4%	0.9%
Food processing	147.3	146.2	-0.2%	153.4	201.0	5.2%	3.0%
Real GDP per product. worker				($ '000 in 1997 prices)			
Total manufacturing	85.3	103.5	4.3%	99.7	113.9	2.4%	2.8%
Food processing	87.0	94.8	1.8%	90.0	83.6	-1.2%	-0.3%

Source: Statistics Canada, CANSIM Tables 379-0017 and 301-0003.

The food processing industry is also an important contributor to employment and employed a total of about 244,000 Canadians in 2002. Total employment in the food processing industry grew at an annual average annual rate of 1.7% between 1990 and 2002 compared to an annual average rate of 0.7% for all manufacturing during the same time period (Table 2).

Labour productivity (real GDP per production worker) in food processing has been declining, whereas labour productivity in total manufacturing has been growing. As indicated in Table 2, labour productivity declined by 0.3% per year between 1990 and 2002 whereas in total manufacturing, labour productivity grew by 2.8% during the same period. The decline in labour productivity in food processing can be attributed to the fact that the number of production workers in the industry grew at a faster rate (3%) than real output (2.6%). On the other hand, the number of production workers in total manufacturing grew at a slower rate (0.9%) than real output (4%). Apart from these reasons, Hassan et al. (2004) also attributes the positive growth in labour productivity in manufacturing to greater R&D and capital investments. Hassan et al. (2004), further attributes the declining labour productivity in food processing to the slower growth in domestic food consumption compared to manufacturing, greater import competition and lack of product or process innovation.

Industry structure and characteristics

The food processing industry (NAICS 311) in Canada consists of 5,444 establishments and encompasses animal food; grain and oilseed; and confectionery; fruit, vegetable and specialty food; dairy products; meat products; seafood products; bakeries and tortilla; and other food.

The number of establishments in food processing remained relatively stable in the 1990s and accounted for about 10% of total manufacturing establishments. It marginally decreased by 0.8% per year between 2000 and 2002 (Table 3). The average size of establishments, as measured by value of shipments per establishment, in the food industry was almost $11.6 million in 2002. Another indicator of size is number of employees. As shown in Table 3, the average number of production workers per establishment in the food processing industry marginally increased from 35 in 2000 to 37 in 2002. In general, food processing has larger-sized establishments on average than total manufacturing, with an average of 37 production workers per establishment in 2002 compared to 28 production workers per establishment for total manufacturing.

Table 3: Structure in total manufacturing and food processing industry, 1990-2002[a]

	1990	1999	Avg. annual % change, 1990-1999	2000	2002	Avg. annual % change, 2000-2002
Number of establishments						
Total manufacturing	38,376	29,822	-2.5%	53,399	54,346	0.9%
Food processing	3,397	3,467	0.2%	5,533	5,444	-0.8%
Value of shipments ($ million)						
Total manufacturing	293,348	492,404	7.5%	562,104	550,244	-1.1%
Food processing	38,967	52,938	4.0%	57,305	63,416	5.3%
Value of shipments per establishment ($ '000)						
Total manufacturing	7,644	16,511	12.9%	10,527	10,125	-1.9%
Food processing	11,471	15,269	3.7%	10,357	11,649	6.2%
Production workers per establishment						
Total manufacturing	35.9	49.6	4.2%	29.5	28.1	-2.3%
Food processing	43.4	48.4	1.3%	35.2	36.9	2.4%

[a] *Data from the Annual Survey of Manufactures (ASM) before and after 2000 are not comparable due to conceptual and methodological changes made to the survey beginning in 2000. These changes included the use of the Business Register to identify in-scope businesses for the ASM, the expansion of coverage to include all manufacturing activity in Canada, and the exclusion of data for the head offices of manufacturers.*

Source: Statistics Canada, Annual Survey of Manufactures.

There are variations in structure across the different food processing industries. About 31% of all food processing establishments are in bakeries and tortilla and another 15% are in meat products. In terms of size as measured by value of shipments and value added, meat products is the largest food processing industry, contributing almost 30% to food processing's value of shipments (Table 4). Three industries: meat products, dairy products, and fruit, vegetable and specialty food, together account for 55% of total value of shipments in food processing. Sugar and confectionery and seafood products are the smallest industries in terms of value of shipments.

When measured by production workers, the meat products industry is still the largest food processing industry, with seafood products, and bakeries and tortilla, the second and third largest respectively. The grain and oilseed, which is the fourth largest in terms of value of shipments, is the smallest in terms of employment. In terms of average employment per establishment, meat products had the highest average of 71 production workers per establishment in 2002 whereas animal food and bakeries and tortilla establishments had the lowest of 13.4 and 19.7 production workers per establishment respectively (Table 4).

Table 4: Characteristics of the food processing industry, 2002

	Number of establish-ments	Production workers	Production workers per establish-ment	Value-added ($ million)	Value-added as ratio of total food value-added	Value-added per production worker ($ '000)	Value of shipments ($ million)	Manufactu-ring intensity[a]
Animal food	547	7,321	13.4	1,267.2	6.2%	173.1	5,240.6	24%
Grain and oilseed	169	7,245	42.9	1,799.5	8.9%	248.4	5,766.9	31%
Sugar and confectionery	194	10,637	54.8	1,621.4	8.0%	152.4	3,396.7	48%
Fruit, vegetable and specialty food	377	20,995	55.7	2,672.4	13.2%	127.3	6,122.3	44%
Dairy products	436	14,695	33.7	2,497.2	12.3%	169.9	9,688.2	26%
Meat products	789	56,118	71.1	4,190.3	20.6%	74.7	18,824.4	22%
Seafood products	687	35,134	51.1	1,275.9	6.3%	36.3	4,477.4	28%
Bakeries and tortilla	1,694	33,368	19.7	2,696.1	13.3%	80.8	4,925.5	55%
Other food	551	15,515	28.2	2,279.7	11.2%	146.9	4,973.7	46%
Total food processing	**5,444**	**201,028**	**36.9**	**20,299.8**	**100.0%**	**101.0**	**63,415.7**	**32%**

[a] *This is the ratio of manufacturing value-added to manufacturing shipments.*

Source: Statistics Canada, Annual Survey of Manufactures.

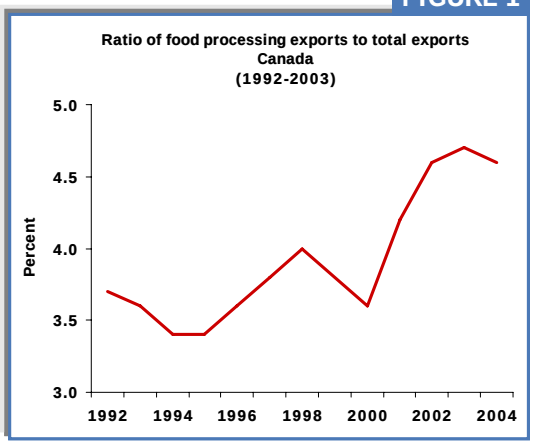
Industry performance and competitiveness

One indicator of industry performance is value added per production worker. This is a measure of labour productivity and varies from industry to industry. As indicated in Table 4, the average labour productivity was $101,000 for food processing relative to $142,000 for total manufacturing in 2002. There are differences among food processing industries in terms of labour productivity. The grain and oilseed industry is the most labour productive among all food processing industries. As indicated in Table 4, the industry's value added per production worker of $248,400 in 2002 was more than twice the average labour productivity of total food processing. The animal food processing industry is the second most labour productive industry with a value added per production worker of $173,100. The seafood products industry, which is one of the smallest food processing industries in terms of value of shipments and value added, is the least labour productive with value added per production worker of only $36,300 in 2002. A labour productivity figure of $80,800 in 2002 for bakeries and tortilla was the third lowest in the food processing industry. The meat products industry also had relatively low labour productivity of $74,700 in 2002 (Table 4).

Manufacturing intensity (ratio of manufacturing value added to manufacturing shipments) is an indicator of industry transformation and how much value is added. It also measures the gross margin of an industry. A decrease in the ratio may indicate increasing non-raw material costs, commoditization of the industry's products or increasing competitive pressure from other players in the supply chain. Manufacturing intensity in food processing has remained relatively stable over time and has ranged between 31% and 35% since 1990. It has also remained consistently lower than total manufacturing for which manufacturing intensity has ranged between 36% and 39% during the same period. Food processing industries also differ in terms of manufacturing intensity (Table 4). Bakeries and tortilla, an industry with relatively smaller establishment size in terms of value of shipments per establishment and employees per establishment, has the highest manufacturing intensity of 55%. Thus for every dollar of shipment in bakeries and tortilla in 2002, $0.55 was value added. At the other extreme is meat products. This is an industry with relatively large average establishment size in terms of value of shipments per establishment and employees per establishment and accounting for 20% of total food processing value added, but with a low manufacturing intensity of 22% in 2002.

All the above industry performance indicators do not provide any indication of the international competitiveness of the food processing industry. However, the competitive environment can impact significantly on innovative activities in the food processing industry and vice versa. Trade can be used as an indicator of the ability to compete in international markets. The food processing industry has become more export-oriented in recent years, exporting more manufactured food products to international markets than before. Canadian exports of manufactured food products have more than doubled over the past decade, increasing at an average annual rate of 10%. The food processing industry accounts for about 4.6% of total Canadian exports compared to just over 3.7% a decade ago (Figure 1). The industry, which was a net importer in the early 1990s, has been consistently exporting more products relative to imports. In 2004, exports of manufactured food products exceeded imports by $5.6 billion.

FIGURE 1



This increase in exports, which may be attributed to increased access to international markets particularly with the North American Free Trade Agreement (NAFTA), provides incentives for innovative approaches to food processing.

Although the food processing industry has become more export-oriented, individual food processing industries differ appreciably from each other in terms of their international competitiveness. The meat products industry has become more export-oriented than any other food industry. Although the industry was adversely affected by BSE and border controls in 2003 and 2004, resulting in a decline in value of exports by 10% between 2002 and 2004, it is still significant in international markets and accounted for 30% of food processing exports in 2004. The meat products industry also had a positive net trade balance of about $4 billion in 2004. As expected, dairy products, a supply managed industry, had a trade deficit of $217 million in 2004. The industry's exports accounted for only 2% of total food processing exports in 2004 and 4% of the industry's value of shipments in 2002. Seafood products is the most export competitive food industry with its exports accounting for 70% of its value of shipments in 2002.

Other measures of international competitiveness are export intensity, import intensity and net export orientation ratio. Export intensity is the ratio of exports to value of shipments and indicates the rate at which an industry is penetrating other international markets over time. An increasing ratio indicates an increasing level of international competitiveness. Import intensity is the ratio of imports to domestic disappearance and indicates the degree of penetration of the domestic market by foreign products. Increasing import intensity indicates that a greater proportion of domestic consumption is supplied from foreign sources. The net export orientation ratio, which is the ratio of net exports to shipments, is an indication of how important imports and exports are relative to shipments. As shown in Table 5, export intensity in the food processing industry has almost doubled from 14.5% in 1992 to 26.5% in 2002 with import intensity also increasing, but at a slower rate than export intensity. Consequently, the net export orientation ratio has increased considerably from -0.1% in 1992 to 6.6% in 2002.

There are also variations in export intensity, import intensity and export orientation ratio across industries. As indicated in Table 5, the seafood products industry has the highest export intensity. Although the industry's export intensity has declined slightly from 75% in 1992 to 74% in 2002, it has remained relatively stable over time. The seafood products industry also has the highest net export orientation ratio (38%) among all food processing industries indicating the significant importance of exports to imports. However, this is a decline from 46% in 1992. The sugar and confectionery industry, which had a negative net export orientation ratio in 2002, recorded the largest increase in net export orientation ratio from -21% in 1992 to -0.5% in 2002. This is an indication of how exports have become significantly important for the sugar and confectionery industry in recent years. The dairy products industry has the lowest export and import intensities. Import intensity for the dairy products industry increased faster than export intensity between 1992 and 2002. This has negatively impacted on the net export orientation ratio which decreased from 0.2 to -1.0 during the same period. This may be due to the relaxation of import controls as a result of WTO rules and agreements. Five food processing industries: grain and oilseed; sugar and confectionery; fruit, vegetable and specialty food; dairy products; and other food, had negative net export orientation ratios in 2002.

Table 5: Export intensity, import intensity and net export orientation ratio for food processing industries

	Export intensity (%)			Import intensity (%)			Net export orientation ratio		
	1992	2002	Percentage point	1992	2002	Percentage point	1992	2002	Percentage point
Animal food	8.0	11.7	3.7	11.3	11.3	0.0	-3.6	0.5	4.2
Grain and oilseed	22.6	30.0	7.4	18.9	30.5	11.6	4.5	-0.8	-5.4
Sugar and confectionery	16.8	41.1	24.3	31.3	41.4	10.1	-21.1	-0.5	20.6
Fruit, vegetable and specialty food	8.0	26.7	18.8	24.2	32.0	7.8	-21.4	-7.8	13.7
Dairy products	2.8	4.8	2.1	2.5	5.8	3.3	0.2	-1.0	-1.2
Meat products	13.4	27.7	14.4	9.7	12.3	2.6	4.1	17.6	13.5
Seafood products	75.2	73.6	-1.6	53.9	57.6	3.6	46.2	37.8	-8.4
Bakeries and tortilla	7.2	23.3	16.1	10.0	16.8	6.8	-3.1	7.7	10.8
Other food	9.2	25.6	16.3	19.4	33.3	14.0	-12.5	-11.7	0.9
Total food processing	**14.5**	**26.5**	**11.9**	**14.5**	**21.2**	**6.7**	**-0.1**	**6.6**	**6.7**

Source: Author's calculations based on data from Statistics Canada.

R&D investments in food processing

Corporate R&D is widely used as a measure of a firm's investment in innovation (Morck and Yeung, 2001). West (2000) also states that a strong R&D program is often considered a key requirement for a firm wanting to have technological advantage over its competitors. R&D is also a mechanism for technology transfer and an input to innovation. R&D investments are thus expected to lead to greater advances in food product development.

Total intramural R&D expenditure in food processing declined from $73 million in 1994 to $66 million in 1999 but picked up again in the past five years and is expected to increase to about $90 million in 2005 (Table 6). R&D expenditures in food processing, however, are increasing at a slower rate than total manufacturing. A decade ago, food processing accounted for 1.7% of total manufacturing R&D expenditures. Today, the industry accounts for only 1.1% of total manufacturing R&D expenditures, although it accounts for about 10% of total manufacturing GDP and 10% of total manufacturing establishments.

Table 6: R&D expenditures in the Canadian food processing industry and total manufacturing, 1994-2005[a]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total intramural R&D expenditure (million dollars)												
Total manufacturing	4,529	4,977	5,117	5,789	6,505	7,077	8,564	9,283	8,155	7,992	8,019	8,149
Food processing	73	84	78	76	67	66	75	71	81	91	91	90
R&D intensity (%)[b]												
Total manufacturing	3.0	2.9	3.1	3.3	3.5	3.2	3.6	4.1	3.6	n/a	n/a	n/a
Food processing	0.4	0.5	0.4	0.4	0.3	0.3	0.4	0.3	0.4	n/a	n/a	n/a
Number of persons engaged in R&D												
Total manufacturing	43,040	45,181	46,010	49,445	51,273	53,383	60,790	61,569	58,668	59,253	n/a	n/a
Food processing	1,007	1,120	1,029	975	937	853	1,029	1,046	1,118	1,245	n/a	n/a
Number of persons engaged in R&D as a ratio of production workers (%)												
Total manufacturing	3.5	3.5	3.4	3.5	3.5	3.6	3.9	3.9	3.8	n/a	n/a	n/a
Food processing	0.7	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.6	n/a	n/a	n/a

[a] *Data for 2003, 2004 and 2005 are preliminary.*
[b] *This is the ratio of R&D expenditure to value-added.*

Source: Statistics Canada, Research and Development in Canadian Industry, CANSIM Table 358-0024.

R&D intensity (R&D expenditure as a ratio of value added) in the food processing industry has remained relatively stable over time and ranged from 0.3% to 0.5% (Table 6). Thus, not more than 0.5% of value added has been invested in R&D activities in the food processing industry. This is relatively small compared to the percent of value added that is invested in R&D in total manufacturing. On average, around 3-4% of value added in total manufacturing has been invested in R&D activities. Table 6 further indicates that less than 1% of production workers are engaged in R&D activities in the food processing industry. This is relatively small compared to almost 4% of production workers engaged in R&D activities in total manufacturing. This is probably because the food industry is characterized as an industry which does not do its own research but brings through to the market place the benefits of research conducted further upstream in the supply chain (Christenson, Rama, and Von Tunzelman, 1996; Pavitt, 1984).

Conclusion

The food processing industry is growing at a slower rate than total manufacturing and its importance in the overall economy has been declining over time. Food processing has relatively larger-sized establishments on average than total manufacturing in terms of employment. The food processing industry has become more export-oriented with significant increases in export intensity and net export orientation ratio. New approaches to production and markets are therefore necessary if the industry is to compete effectively in international markets and be sustainable.

Whereas, it is well known that R&D is an input to innovation, which is needed to maintain a competitive edge, a relatively low percentage of value added is being invested in R&D in the food processing industry. As the food processing industry has several sub-industries that vary in terms of structure and characteristics, the ability and the motivation to invest in R&D and develop product and process innovation are therefore expected to vary by industry.

Section 3

Methodology

Survey

This study uses data from the 2004 Innovation in the Food Processing Industry Survey conducted by Statistics Canada for Agriculture and Agri-good Canada.

The initial stage of the survey involved a review of the food processing industry and available information about innovation. Based on this review, a survey on innovation in the food processing industry was designed. The survey consists of eight sections covering general characteristics of establishments, the competitive environment, R&D, creative innovation, support activities of creative innovation, government support programs, obstacles to innovation and restructuring business relationships (See Appendix A for survey questionnaire).

The survey, which was conducted in the fall of 2004, is a target population census consisting of all food processing establishments under the NAICS code 311 and with annual revenue of at least $1 million. The survey's framework came from the Statistics Canada's Business Register (BR). This is a central listing of all businesses operating in Canada. The statistical unit is the establishment which was identified using the establishment number from the BR.

The survey was done in two stages. In the first stage all food processing establishments with annual revenues of at least $250,000 (4,292 establishments) were contacted in order to verify the information and the appropriate contact person to receive the questionnaire. It was decided after this first contact to include only establishments with annual revenues of at least $1 million to increase the probability of surveying food processing establishments actually involved in food processing. This process identified 1,889 establishments that are still in operation and fit the criteria for the survey. The second stage involved the mailing out of the survey to the individual respondents identified from the 1,889 establishments. Follow ups were done by telephone interviews.

Degree and extent of innovation is expected to vary by size of establishment, location, type of product manufactured, and country of control. The population was therefore stratified by these variables. For size, the population was stratified by number of employees and total annual sales.

Categories for number of employees included: less than 20, 20-49, 50-199, and 200 and more. In terms of total annual sales, the categories included less than $5 million, $5 - $10 million, $10 -$20 million and $20 million and up. The population was also stratified into 10 industries: Animal Food Manufacturing (animal food); Grain and Oilseed Milling (grain and oilseed); Sugar and Confectionery Product Manufacturing (sugar and confectionery); Fruit and Vegetable Preserving and Specialty Food Manufacturing (fruit, vegetable and specialty food); Dairy Product Manufacturing (dairy products); Meat Product Manufacturing (meat products); Poultry Processing (poultry processing); Seafood Product Preparation and Packaging (seafood products); Bakeries and Tortilla Manufacturing (bakeries and tortilla); and Other Food Manufacturing (other food) and three country of control variables (Canada, the US and other foreign countries).

The overall response rate for the survey was 43% and varies by size, region and industry (Table 7). Medium-sized establishments (establishments with 50-199 employees) had a lower response rate compared to smaller and larger-sized establishments. Response rates were 45% for smaller-sized establishments, 39% for medium-sized establishments and 42% for larger-sized establishments. The response rate also varied by region and ranged from 41% in Atlantic Canada to 44% in the Prairies. Industry response also ranged from 38% for bakeries and tortillas to 48% for grains and oilseed.

Table 7: Survey response rate

VARIABLE	COMPLETED	RESPONSE RATE (%)
Number of employees		
<20	224	44.6
20-49	251	46.0
50-199	237	39.0
200 and more	97	41.8
Region		
Atlantic Canada	118	40.5
Quebec	206	43.9
Ontario	259	42.8
Prairies	132	44.3
British Columbia	94	42.2
Industry		
Animal food	118	47.4
Grain and oilseed	31	47.9
Sugar and confectionery	37	47.6
Fruit, vegetable and specialty food	65	41.6
Dairy products	82	45.1
Meat products	118	44.6
Poultry processing	36	45.1
Seafood products	115	41.0
Bakeries and tortilla	136	38.0
Other food	71	40.1
Total food processing	**809**	**42.9**

Source: Statistics Canada, Innovation in the Food Processing Industry Survey 2004.

In the 'Innovation in the Food Processing Industry Survey 2004', innovation includes product and process innovation. In the survey, product innovation is defined as the introduction of any good or service, whose fundamental characteristics or intended uses are new or differ significantly from other products or services produced by the industry in North America. This may involve the development of a brand new product, significant modifications to an existing product or the purchase of the right to produce or copy products that are not currently available for sale in North America. The survey also defines process innovation to include production techniques, production processes, systems monitoring, and biotechnology processes that are introduced by an establishment and new to the industry in North America. Process innovation may be introduced by developing brand new equipment, techniques and processes, by significantly modifying existing equipment, techniques and processes or by purchasing the right to use or copy equipment, techniques and processes that are not currently used in the industry in North America.

The definition of innovation in this survey differs from that of the 1999 innovation Survey by Statistics Canada in which innovation was defined as a new product or process whose characteristics or intended uses differ significantly from those of the establishment's previously-produced product or process. In the 'Innovation in the Food Processing Industry Survey 2004', the introduction of a product or process cannot be considered innovation unless it is the first of its kind in North America.

Data tabulation

The data presented in this report are population estimates, which have been obtained by converting survey results to population values by applying appropriate weights. Weighted frequency distributions and cross tabulations are used in this analysis. The coefficient of variation (CV) and confidence intervals (CI) at the 95% confidence level are calculated for each of the estimates. These determine the degree of variability of the estimates. The higher the variability associated with an estimate, the less reliable is that estimate. Those estimates with very high variabilities (with a CV of more than 33.3%) are therefore not reported.

Cross tabulations are provided by location of establishments, size of establishments, industry and country of control. Differences in measures between establishments by locations, sizes, products and country of control are not tested statistically and should be used with caution as such differences may not be statistically significant.

Section 4

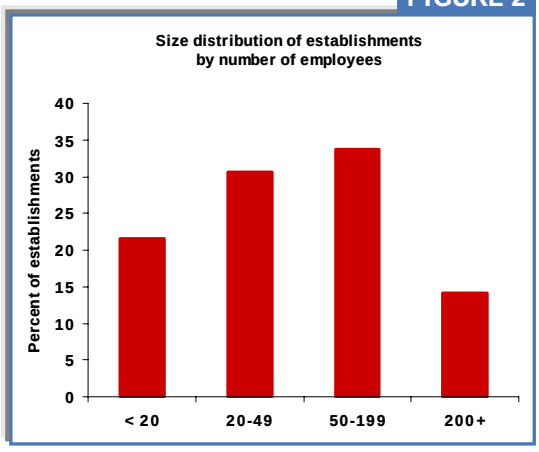
The food processing establishments

In Section 2, an overview of the food processing industry was provided using data from the Annual Survey of Manufactures and other sources. In this section, the characteristics of food processing industries are discussed using data from the "Innovation in the Food Processing Industry Survey 2004". The analysis of this section thus concentrates on establishments with more than $1 million in annual revenue. The discussion focuses on the characteristics of establishments that are expected to influence R&D and innovation. Such characteristics include establishment size, principal activity, country of control and markets.

Size of establishments

The analysis of size of establishments confirms the conclusion in Section 2 that the food processing industry is dominated by many small-sized (establishments with less than 50 employees) and a few large-sized establishments (establishments with 200 or more employees). As indicated in Figure 2, about 52% of food processing establishments are considered small-sized with only 14% having 200 or more employees. The size of establishments has not changed over time. According to the Advanced Technology in the Canadian Food Processing Industry survey of 1999, 52% of establishments had between 10 and 50 employees and 10% had more than 250 employees.

FIGURE 2



Size of establishment also varies by industry. Most of the establishments in some industries are considered small-sized with less than 50 employees (Table 8). In animal food, for example, as much as 82% of establishments are small-sized in terms of employment. The poultry processing

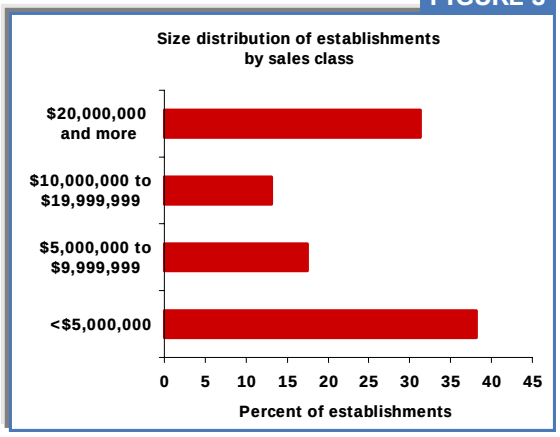
industry, on the other hand, has relatively large-sized establishments. In the poultry processing industry, only about 18% of establishments reported less than 50 employees with as much as 42% of establishments reporting 200 and more employees.

Table 8: Distribution of establishments by number of employees and industry

INDUSTRY	<20	20-49	50-199	200 +
		% of establishments		
Animal food	46.7	35.7	15.9	1.7
Grain and oilseed	13.7	28.2	51.1	7.0
Sugar and confectionery	24.2	19.4	29.7	26.7
Fruit, vegetable and specialty food	13.5	26.8	39.3	20.5
Dairy products	13.0	40.9	30.3	15.8
Meat products	28.3	24.5	31.2	16.0
Poultry processing	2.5	15.1	39.9	42.4
Seafood products	10.5	20.3	51.7	17.6
Bakeries and tortilla	20.3	36.3	35.1	8.2
Other food	23.2	43.3	22.0	11.5
Total food processing	**21.6**	**30.6**	**33.7**	**14.1**

The size of establishments, according to value of sales, also supports the conclusion that the food processing industry is dominated by many small-sized establishments. About 31% of establishments have total sales from food / feed production of $20 million or more with over 50% of establishments reporting sales of less than $10 million in 2003 (Figure 3).

FIGURE 3



Manufacturing activities

The stages in the value chain where an establishment's activities are concentrated have implications for innovation. Whether an establishment's activities involve processing of primary agricultural products or more value addition will determine the intensity of R&D and the type of innovation. To determine the main activities of establishments, respondents were asked to identify the principal food / feed manufacturing activity of their establishment based on proportion of annual total sales. As indicated in Table 9, almost 60% of all food processing establishments reported that their principal manufacturing activity involves the manufacture of food products ready for human consumption such as breakfast cereal, frozen dinners, canned foods, sausages, salad dressing and pet food. Thirty percent of establishments concentrate on the primary processing of raw agricultural products (example, flour milling, feed milling, animal slaughter and oilseed processing) with only 12% involved in the supply of semi-prepared food products for use in further processing such as flour mixes, fruit desert fillings and dairy-based ingredients. Thus, most food processing establishments are closer to the end of the value chain (consumers) than to primary producers.

Table 9: Distribution of establishments by manufacturing activities and industry

PRINCIPAL ACTIVITY	Primary processing of raw agricultural products[a]	Supply of semi-prepared food products for use in further processing[b]	Manufacture of food products for end-users[c]
		% of establishments	
Animal food	67.7	8.0	24.3
Grain and oilseed	64.5	18.9	16.7
Sugar and confectionery	0.0	11.5	88.5
Fruit, vegetable and specialty food	9.4	5.7	84.9
Dairy products	8.3	15.7	76.0
Meat products	41.6	12.3	46.1
Poultry processing	69.5	8.2	22.3
Seafood products	50.8	6.0	43.1
Bakeries and tortilla	1.4	11.1	87.5
Other food	9.4	29.3	61.4
Total food processing	**30.2**	**12.0**	**57.9**

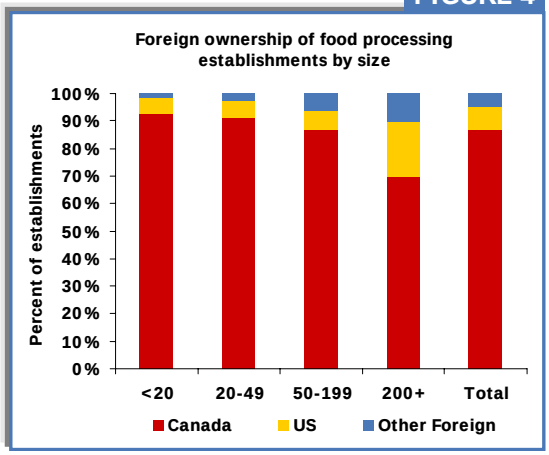
[a] *Examples are flour milling, feed milling, animal slaughter and oilseed processing.*
[b] *Some examples include flour mixes, fruit desert fillings and dairy-based ingredients.*
[c] *Examples are breakfast cereal, frozen dinners, canned foods, sausages, salad dressing and pet food.*

As expected, establishments in animal food; grain and oilseed; poultry processing; and seafood products, are concentrated on the primary processing of raw agricultural products. For example, almost 70% of establishments in animal food and poultry processing are engaged in the processing of raw primary agricultural products. On the other hand, three industries: sugar and confectionary; bakeries and tortilla; and fruit, vegetable and specialty food, make up more than 85% of the establishments engaged in the manufacture of food products for end users. Meat products and seafood products establishments are likely to be involved in both the primary processing of raw agricultural products and the manufacture of food products for end users.

Country of control

Multinational enterprises are said to have greater advantages in terms of access to new technologies and innovative ideas. According to the theory of multinational firms, expansion across national borders is associated with the need to exploit hard-to-transfer skills that are related to marketing or technology (Caves, 1982). In much the same way, a multinational firm has the advantage of transferring and building on an innovative idea developed from one geographic region into a new innovation in another region.

FIGURE 4



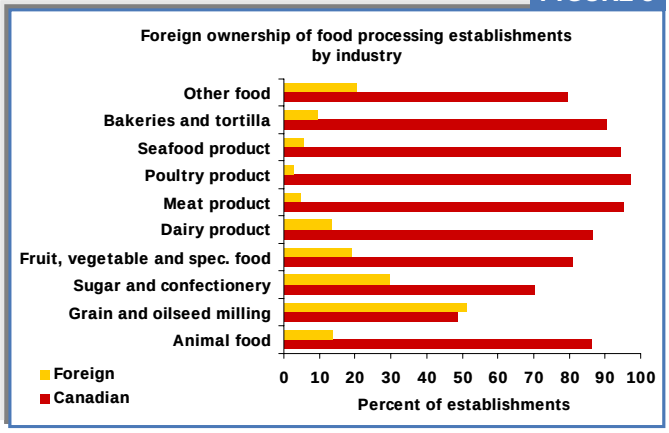
Survey respondents were asked to indicate the majority ownership of their enterprise. Based on the survey, 87% of food processing establishments can be classified as Canadian owned. Only 8% and 3% of establishments reported majority ownership from the US and other foreign countries respectively (Figure 4). This is very similar to the

findings from the 1999 Advanced Technology in the Canadian Food Processing Industry survey, in which 89% of food processing establishments were controlled by firms with head offices in Canada.

Country of control is related to size of establishment. As shown in Figure 4, as much as 93% of establishments with less than 20 employees are Canadian controlled. However, of all the establishments with 200 or more employees, only 70% have majority Canadian ownership and 21% have US control.

The extent of domestic control also varies by product. Grain and oilseed milling is a very unique industry with a higher percentage of foreign control. As indicated in Figure 5, about 51% of grain and oilseed establishments indicated majority foreign ownership with about 48% reporting US control. This is because international grain trade lends itself to economies of scale, most particularly in information and the major grain or commodity traders have integrated globally to help them source and sell grain and other commodities all round the world. For example, Cargill, a US-based company, is a major player in the Canadian grain and oilseed industry. Meat products establishments, on the other hand, have a significantly lower proportion of foreign ownership (5.7%). However, the two largest meat processing companies in Canada, Cargill Foods and Lakeside Packers, are foreign-controlled and represent approximately 70% of the beef production in Canada. The survey also indicates that in the dairy products industry, there is no US control but 11% of establishments reported European control. This is probably because of European multinationals such as Parmalat, which is a major player in the Canadian dairy manufacturing industry.

FIGURE 5



Parent companies

Some establishments belong to parent companies which are the highest reporting levels of the establishment. This has implications for R&D and innovation as an establishment may not be directly engaged in innovation but may be producing innovative products developed by the parent company. According to this survey, 43% of establishments indicated that they have parent companies (Table 10). The parent companies, apart from having production units in Canada also have production units in other foreign locations. When establishments were asked to indicate all Canadian regions and countries in which the parent company has production units, 92% indicated that they have other production units in Canada. About 17%, 9% and 6% of establishments reported that their parent companies have production units in US, Europe and Mexico, respectively. About 7% of establishments also mentioned production units in Asia and another 6% reported production units of parent companies in other parts of the world.

Larger-sized establishments are more likely to have a parent company. Whereas 74% of establishments with 200 or more employees reported having a parent company, only 25% of establishments with less than 20 employees indicated that they have a parent company. However, size does not matter in terms of the location of production units. There are also no significant varia-

tions from the general trend across industries in terms of parent companies and location of production units (Table 10). As expected, foreign-controlled establishments are more likely to have parent companies and production units in other countries.

Table 10: Establishments with parent companies of food processing establishments by size, country of control and industry[a,b]

	ESTABLISHMENTS WITH PARENT COMPANY
	% of all establishments
Employment size class	
<20	24.3
20-49	29.0
50-199	48.5
200+	74.5
Country of control	
Canada	34.0
US	91.0
Other foreign	87.0
Industry	
Animal food	53.7
Grain and oilseed	61.8
Sugar and confectionery	42.5
Fruit, vegetable and specialty food	48.5
Dairy products	47.9
Meat products	40.1
Poultry processing	49.4
Seafood products	34.4
Bakeries and tortilla	24.6
Other food	41.7
Total food processing	**43.1**

[a] *Percentages do not add up to 100 due to multiple responses.*
[b] *A parent company is the highest reporting level of an establishment.*

Dominant market

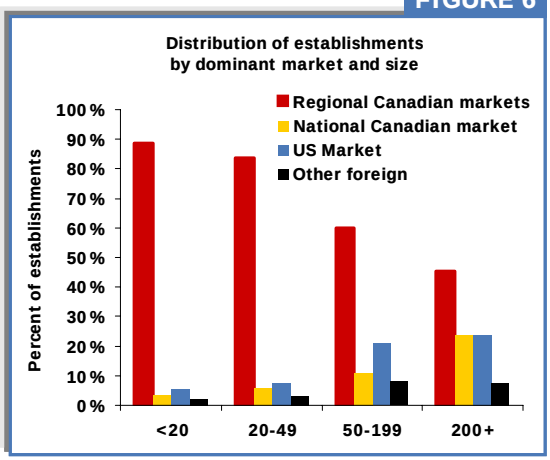
Establishments that sell mostly to foreign markets are expected to use both product and process innovation to produce and market high value added goods. According to Baldwin et al. (1999), firms that are active in foreign markets are expected to use more sophisticated distribution and communications technologies.

When establishments were asked to indicate the dominant market for their products, about 71% of establishments reported regional Canadian markets as their dominant market. Only 10% reported the national Canadian market as their dominant market. About 14% had US as their dominant market and 5.2% reported other foreign markets as their dominant market (Table 11). Dominant markets vary by establishment size, industry and country of control. National Canadian markets and foreign markets are more important to larger-sized establishments than to smaller-sized establishments. As the size of an establishment increases, the proportion of estab-

lishments with national Canadian and foreign markets as their dominant market increases. According to Figure 6, almost 90% of establishments with less than 20 employees concentrate on regional Canadian markets. On the other hand, only 45% of establishments with 200 or more employees have regional Canadian markets as their dominant market. This is because many of the larger-sized establishments have the ability to comply with both federal and international standards requirements whereas only a few of the smaller-sized establishments have systems in place to meet both sets of requirements. They are also large enough to have economies of scale in marketing to different markets.

Country of ownership is also positively related to dominant markets. Whereas about 75% of Canadian-controlled establishments have regional Canadian markets as their dominant market, only 55% and 38% of US and other foreign-controlled establishments respectively reported regional Canadian markets as their dominant market. This is an indication of the ability of multinationals to use their international links to penetrate national and international markets.

FIGURE 6



Food processing industries also show variations in dominant markets. As shown in Table 11, a greater proportion of establishments in animal food (98%); poultry processing (97%); dairy products (97%); other food (92%); meat products (90%) have Canadian markets as their dominant market. On the other hand, a relatively smaller proportion of establishments in the seafood products industry (27%); have Canadian markets as their dominant market. As shown earlier in Section 2, export intensity ratios are high for the seafood products industry.

Table 11: Distribution of establishments by dominant market and industry

INDUSTRY	Regional Canadian markets	National Canadian market	US market	Other foreign market
	% of establishments			
Animal food	96.7	0.9	0.8	1.6
Grain and oilseed	55.3	16.7	24.3	3.7
Sugar and confectionery	41.8	26.7	29.1	2.4
Fruit, vegetable and specialty food	68.0	21.0	7.3	3.7
Dairy products	81.0	15.5	2.4	1.2
Meat products	84.2	5.8	5.5	4.4
Poultry processing	92.2	5.2	2.7	0.0
Seafood products	23.9	2.8	48.6	24.7
Bakeries and tortilla	82.1	7.1	10.8	0.0
Other food	72.6	19.5	7.8	0.0
Total food processing	**71.3**	**9.6**	**13.9**	**5.2**

Conclusion

The food processing industry is dominated by many small and a few large establishments. Size of establishments varies by industry. Poultry processing; sugar and confectionery; fruit, vegetable and specialty food have a relatively greater percentage of larger establishments whereas animal food; grain and oilseed; and bakeries and tortilla industries are dominated by many small establishments.

Most food processing establishments produce for end users (consumers). However, there are notable differences across industries. Establishments in animal feed processing, grain and oilseed, and poultry processing are concentrated on primary processing of raw agricultural products. On the other hand, four industries: sugar and confectionary; bakeries and tortilla; fruit, vegetable and specialty food; and dairy products, are more likely to be engaged in the manufacture of food products for end users. Meat products and seafood products establishments are likely to be involved in both the primary processing of raw agricultural products and the manufacture of food products ready for end users.

Country of control also varies by size and industry. Generally, larger-sized establishments are more likely to be foreign-controlled. Foreign-controlled establishments are also more likely to be found in grain and oilseed; sugar and confectionery; and other food. Establishments in poultry processing; meat products; dairy products; bakeries and tortillas and animal food are more likely to be domestically-controlled.

Regional Canadian markets are the dominant market for most food processing establishments but national Canadian markets and foreign markets are more important to larger-sized establishments than to smaller establishments. Foreign-controlled establishments also tend to have a greater global reach than Canadian-controlled establishments.

Section 5

Competitive environment

The ability of an establishment to compete in both the domestic and international markets provides incentives to innovate in order to maintain or improve competitiveness. Consumers, who now have a wide range of product choices, are becoming more conscious of certain food attributes such as food safety and quality. The continuous changes in consumer demand and the ever-present mix of opportunities, threats and uncertainties in the global economy will continue to drive the competitive intensity in the food processing industry. As indicated in Section 2, international competitiveness measures such as export intensity, import intensity and net export orientation ratio have improved for the food processing industry as a whole. This is an indication of the ability of the Canadian food processing industry to compete internationally. However, as competition becomes more intense globally, Canadian establishments need to adjust their strategies to meet the global market challenges.

There are several factors that may determine or have an impact on the competitive environment and competitive intensity. According to Baldwin et al. (1999), the nature of competition is determined by the characteristics of the product market, the production process and the structure of the market. The structure of the market is determined by the number of establishments, their sizes and the market power, the type of products or brands and the degree of integration or consolidation. Other factors that may have an impact on the competitive environment include government regulations, other international standards, and the value of the dollar.

In this section, the competitive environment and the competitive intensity of the food processing industry are discussed. Establishments may need to develop different strategies to address their individual competitive challenges. For example, export-oriented establishments may need to develop strategies to deal with the competitive challenges in their target international markets.

Factors affecting competitive abilities

To assess the competitive environment in which food processing establishments operate and what drives it, establishments were asked to respond to questions related to factors impacting competitiveness. Such factors include access to raw products at competitive prices; the impor-

tance of the value of the Canadian dollar; the impacts of mergers, acquisitions and consolidations; access to distribution channels; the impacts of stringent consumer requirements for food safety, quality and environmental standards; and outdated, lack of or inflexible food safety regulations and standards. When asked to rate these factors as having a minor, moderate or major impact on ability the to compete, increased value of the Canadian dollar, consolidation of food retailers and wholesalers, and the availability of competitively-priced raw agricultural products were considered the top three factors impacting competitiveness. Almost 47% of establishments mentioned the increased value of the Canadian dollar as a factor with moderate or major impacts on their ability to compete. Almost 30% indicated that the dollar is a minor factor impeding their ability to compete (Table 12). The dollar is an issue because of the relatively low and declining productivity of the food processing industry. As discussed in Section 2, productivity in the food processing industry generally declined at an average rate of 0.3% per year from 1990 to 2002. The concern over the increased value of the dollar is particularly important for establishments that have foreign outlets as their dominant market. Another factor mentioned as having a moderate or major impact on competitiveness by 37% of establishments is the availability of competitively priced raw agricultural products for processing. This may be reflective of supply managed commodities, where the price of raw products for processing are determined using a cost of production formula. Increased concentration in retail and wholesale markets was reported as another factor with a moderate or major impact on competitiveness by 36% of establishments. With greater consolidation in the retail end of the chain, processors are at a greater disadvantage in negotiating and selling to retailers and wholesalers.

The factors considered by food processing establishments to be of less importance to their competitive ability are consolidation of equipment suppliers and / or packaging suppliers; lack of food safety regulations / national standards; mergers and acquisitions by competitor firms; and more stringent buyer requirements concerning the environment. This may also imply that establishments perceived these factors as a non-issue. For example, establishments' that responded that a lack of food safety regulations is a minor concern for competitiveness may reflect a perception by the industry that there are adequate food safety regulations or national standards that are recognized by consumers.

Table 12: Impact of selected factors on establishments' ability to compete

FACTOR	MINOR	MODERATE	MAJOR
		% of establishments	
Availability of competitively-priced raw agricultural products for processing	32	22	15
Mergers and acquisitions by competitor firms	41	17	6
Consolidation of equipment suppliers and/or packaging suppliers	50	11	2
Consolidation of food retailers and/or wholesalers	31	21	15
Restricted access to distribution channels	32	20	11
More stringent buyer requirements/standards for food safety and quality	40	30	13
More stringent buyer requirements/practices concerning the environment	51	18	6
Outdated/inflexible food safety regulations	42	24	12
Lack of food safety regulations/national standards	48	11	5
Increased value of the Canadian dollar against the US dollar	28	18	29

Table 13 indicates that factors that impact on competitiveness vary by establishment size. The value of the Canadian dollar is the leading concern for establishments of all sizes in terms of their ability to compete. Although the value of the dollar is the most important factor in the competitiveness of establishments, the degree of concern intensifies with establishment size. This is not unexpected as exporters will be more concerned about the increase in the dollar value than importers and larger-sized establishments are generally exporters with majority of their sales revenue from foreign markets. Establishments with less than 20 employees considered buyer requirements or food safety and quality standards and inflexible food safety requirements as the second and third most important factors impacting their ability to compete. Establishments with 50 or more employees considered consolidation of retailers and wholesalers, and the availability of competitively-priced raw agricultural products as the other two most important factors affecting their competitive ability (Table 13).

Table 13: Impact of selected factors on establishments' ability to compete by size

FACTOR	<20	20-49	50-199	200+
	% of establishments reporting factor as having major impact			
Availability of competitively-priced raw agricultural products for processing	11.8	14.0	19.0	13.9
Mergers and acquisitions by competitor firms	6.5	9.6	3.1	5.3
Consolidation of equipment suppliers and/or packaging suppliers	3.3	1.8	1.5	4.0
Consolidation of food retailers and/or wholesalers	11.3	15.0	12.8	28.0
Restricted access to distribution channels	11.7	14.7	8.7	9.7
More stringent buyer requirements/standards for food safety and quality	16.4	12.4	11.5	10.3
More stringent buyer requirements/practices concerning the environment	9.9	4.5	4.2	4.4
Outdated/inflexible food safety regulations	15.4	11.6	10.5	8.2
Lack of food safety regulations/national standards	7.3	6.1	3.2	0.7
Increased value of the Canadian dollar against the US dollar	18.8	21.6	33.6	46.6

According to this survey, larger-sized establishments are more concerned about consolidation of food retailers and/or wholesalers than smaller-sized establishments. About 28% of larger-sized establishments mentioned that consolidation of food retailers/or wholesalers is a major factor affecting their ability to compete (Table 13). On the other hand, food safety and quality requirements and standards, generally, are not major factors impacting the ability of large-sized establishments to compete as it is for smaller-sized establishments. The reason for this may be that larger-sized establishments have food safety and quality systems in place to meet the existing national and foreign requirements and standards. Some larger-sized establishments have standards that are above the existing national standards.

Factors perceived to affect competitiveness are also related to country of control. As indicated in Table 14, the value of the Canadian dollar is still the most important factor for all establishments. However, the other top two major factors vary by country of control.

Table 14: Impact of selected factors on establishments' ability to compete by country of control

FACTOR	COUNTRY OF CONTROL		
	Canadian	US	Other foreign
	% of establishments reporting factor as having major impacts		
Availability of competitively-priced raw agricultural products for processing	15.0	20.1	9.9
Mergers and acquisitions by competitor firms	6.8	2.7	0.0
Consolidation of equipment suppliers and/or packaging suppliers	2.5	1.5	0.0
Consolidation of food retailers and/or wholesalers	16.3	7.1	11.4
Restricted access to distribution channels	12.5	3.4	3.3
More stringent buyer requirements/standards for food safety and quality	12.6	12.2	15.4
More stringent buyer requirements/practices concerning the environment	5.9	3.5	3.6
Outdated/inflexible food safety regulations	12.5	2.9	10.4
Lack of food safety regulations/national standards	5.3	0.0	0.0
Increased value of the Canadian dollar against the US dollar	29.3	22.2	26.2

With the exception of establishments in dairy products, grain and oilseed, and poultry processing, the value of the Canadian dollar is the major factor impeding competitiveness for a greater proportion of establishments in the food processing industry (Table 15). In dairy products and poultry processing, consolidation of food retailers and / or wholesalers is perceived as the most important factor impeding their ability to compete. This may be explained by the fact that establishments in these two industries depend very much on domestic demand and with the high level of concentration in the Canadian retail and wholesale markets, any further consolidation will significantly affect the negotiation power of processors and their ability to compete. For the dairy products industry, this may also be due to the prevalence of large retailers selling private label dairy products. In the grain and oilseed industry, availability of competitively-priced raw agricultural products is the top factor impeding establishments' ability to compete.

Intensity of competition

Depending on the competitive environment, establishments can compete in several different ways. According to Baldwin et al. (1999), establishments or firms can either compete through the introduction of new products, quality improvements or lower prices. Establishments that do not produce differentiated products may have to produce at a lower cost than its rivals to enable it sell at a lower price to increase its market share. Some establishments may develop strategies to produce new products or improve quality to differentiate their products from other competitors. Other establishments may use a combination of strategies to gain a competitive advantage.

Table 15: Impact of selected factors on establishments' ability to compete by industry[a]

FACTOR	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of establishments reporting factor as having major impacts									
Availability of competitively-priced raw agricultural products for processing	8.5	36.5	3.0	14.8	22.3	20.8	21.3	22.2	7.6	8.1
Mergers and acquisitions by competitor firms	7.6	2.7	2.4	4.5	8.6	8.1	2.5	4.8	7.5	4.1
Consolidation of equipment suppliers and/or pack-aging suppliers	1.7	–	–	4.9	2.7	3.5	–	0.8	3.6	1.4
Consolidation of food retailers and/or wholesalers	6.7	7.0	10.3	20.7	24.3	22.1	37.8	6.0	13.1	17.6
Restricted access to distribution channels	2.5	2.7	7.3	17.3	15.7	16.8	10.7	8.4	11.7	15.4
More stringent buyer requirements/standards for food safety and quality	12.3	21.1	10.9	13.8	8.3	21.4	7.8	7.5	13.1	11.0
More stringent buyer requirements/practices con-cerning the environment	7.7	–	–	9.4	9.5	6.0	2.7	2.1	5.1	6.9
Outdated/inflexible food safety regulations	16.9	3.5	2.4	20.7	6.2	21.1	17.0	2.8	11.1	6.8
Lack of food safety regulations/national standards	2.9	0.0	0.0	9.0	2.4	9.8	5.7	0.0	4.7	8.3
Increased value of the Canadian dollar against the US dollar	15.6	26.0	33.9	31.5	7.4	27.9	30.7	64.6	17.1	30.2

[a] *Percentages do not add up to 100 due to multiple responses.*
– *No establishment reported a factor as having major impacts.*

Food processing establishments were asked to rate the intensity of competition in their industry in a number of areas including product price, product quality, flexibility in responding to customer needs, customer service, customization of products, ability to offer a wide range of related products, and frequency of introducing new or improved products. The intensity of competition of these different areas was rated by establishments as low, medium or high. Product price, customer service and product quality were considered the three most important factors. About 64% of establishments rated the intensity of product price as high. About 37% of establishments also rated customer service to have a high level of competitive intensity with 34% indicating that product quality has a high level of competitive intensity (Table 16). Product price, product quality and customer service were also the three top areas of competitive intensity when plant managers were asked to rate the intensity of competition in the 1999 Advanced Technology in the Canadian Food Processing Industry Survey.

As indicated in Table 16, the three least important areas in terms of competitive intensity as reported by establishments are frequency of introducing new or improved products; offering of a wide range of related products and customization of products. In other words, the introduction of new products is not considered critical by Canadian food processing establishments. This may imply commoditization of the industry and less product differentiation which may require less R&D and innovation activities. However, as discussed in Section 1, innovation is critical for long-term international competitiveness of an industry. This finding therefore raises concerns about the food processing industry's ability to compete in the world market in the long run.

Intensity of competition varies by establishment size. The top three factors of high competitive intensity for establishments, with less than 200 employees are product price, customer service and product quality. For establishments with 200 or more employees, the top three factors are product price, customer service, and flexibility in responding to customer needs (Table 16). This may be due to the fact that many of the larger-size establishments have quality systems in place and are also likely to be involved in product branding. Thus, to such establishments, responding to customer needs is more important for competition than product quality.

Table 16 further shows that the top three areas of competitive intensity are the same for establishments that are Canadian or US-controlled: product price, customer service and product quality. For other foreign-controlled establishments, the top three factors with high competitive intensity are product price, flexibility in responding to customer needs and customer service. Such establishments consider product quality as the fourth most important factor in terms of competitive intensity.

Competitive intensity varies by industry. For the sugar and confectionery, price is only ranked third behind frequently introducing new / improved products and customer service for competitive intensity (Table 16). This may be because there are probably more substitutes for the industry than in the other food industries and therefore what is more important is making sure there are new / improved products and ensuring that customers are satisfied with product.

In bakeries and tortilla, and poultry processing, product price, flexibility in responding to customers' needs and customer service are the top three ranked factors in competitive intensity. For the other remaining industries, product price, product quality and customer service are the top three factors affecting competitive intensity.

Table 16: Factors and their competitive intensity by size, country of control and industry

	Product price	Product quality	Flexibility in responding to customers needs	Customer service	Customization of products	Offering a wide range of related products	Frequently introducing new/ improved products
Employment size class	% of establishments reporting factor with high competitive intensity						
<20	56.1	32.4	32.2	34.9	27.5	28.2	18.0
20-49	64.5	35.5	30.7	37.4	22.0	22.7	18.4
50-199	65.7	34.3	33.3	34.1	22.6	18.6	18.7
200 and more	71.9	34.6	40.2	42.9	16.1	20.0	25.9
Country of control	% of establishments reporting factor with high competitive intensity						
Canada	62.3	33.3	32.2	34.8	21.8	22.1	18.5
US	74.8	40.2	31.1	47.9	30.7	23.0	27.4
Other foreign	79.3	42.8	56.3	48.0	21.7	20.6	23.9
Industry	% of establishments reporting factor with high competitive intensity						
Animal food	73.7	35.7	35.1	46.5	31.1	27.4	17.2
Grain and oilseed	81.1	61.7	46.3	46.3	19.4	15.9	15.9
Sugar and confectionery	46.1	23.0	42.5	47.9	26.1	27.9	50.9
Fruit, veg. and specialty food	73.2	39.7	31.4	38.1	26.5	24.9	24.9
Dairy products	65.9	38.0	29.4	35.0	19.3	30.3	28.2
Meat products	65.8	30.2	28.2	29.3	15.2	14.7	8.7
Poultry processing	77.2	19.2	57.0	35.5	22.5	13.7	5.8
Seafood product	59.0	32.7	22.4	22.0	12.0	9.2	7.5
Bakeries and tortilla	57.0	33.3	37.0	43.3	27.9	30.3	27.3
Other food manufacturing	56.8	36.1	33.9	34.5	27.2	22.4	21.9
Total food processing	**64.1**	**34.3**	**33.3**	**36.5**	**22.6**	**22.1**	**19.5**

[a] *Percentages do not add up to 100 due to multiple responses.*

Conclusion

Tables 17 and 18 provide a summary of the ranking of factors perceived to impact competitive ability and the main areas with intense product market competition. The top three most important factors impacting the ability of establishments to compete include the increased value of the Canadian dollar, consolidation of food retailers and wholesalers and availability of competitively-priced raw agricultural products for processing. A relatively high percentage of establishments perceive the increased value of the Canadian dollar as a major impediment to their ability to compete. In terms of intensity of competition, product price, product quality and customer service are the top three areas with high competitive intensity. Frequency of introducing new or improved product is an area of low competitive intensity. This has implications for innovation in the food processing industry.

Table 17: Factors impacting competitive ability in the food processing industry

RANK	Factors having a major impact on competitive ability
1	Value of the Canadian dollar
2	Consolidation of food retailers and/or wholesalers
3	Availability of competitively priced raw agricultural products for processing
4	More stringent buyer requirements/standards for food safety and quality
5	Outdated/inflexible food safety regulations
6	Restricted access to distribution channels
7	More stringent buyer requirements/practices concerning the environment
8	Mergers and acquisitions by competitor firms
9	Lack of food safety regulations/national standards
10	Consolidation of equipment suppliers and/or packaging suppliers

Table 18: Intensity of competition in the food processing industry

RANK	Areas of high intensity of competition
1	Product price
2	Customer service
3	Product quality
4	Flexibility in responding to customer's needs
5	Customization of products
6	Offering a wide range of related products
7	Frequently introducing new/improved products

There are also broad differences in factors impacting competitive ability, areas of competitive intensity and sources of competition by establishment size, country of control, location and industry. Trade-oriented industries such as seafood products; meat products; sugar and confectionery; and fruit, vegetable and specialty food are more likely to perceive the increased value of the Canadian dollar as a major impediment to competitiveness than domestically-focussed industries. Whereas the value of the Canadian dollar is the major factor for competitiveness by a greater proportion of establishments in almost all industries, availability of competitively-priced

raw agricultural product for processing is perceived as the most important factor impeding competitive ability of a greater proportion of establishments in the grain and oilseed industry. All food processing industries rated product price as the area of highest competitive intensity with the exception of sugar and confectionery, where frequency of introducing new/improved products is considered an area with high competitive intensity.

Section 6

Inputs and supporting activities to innovation

There are several supporting activities needed for the development of an innovation and its protection after it has been developed. Stoneman (1996) noted the three stages in the process of innovation, as was identified by Shumpeter, to include the creation of new ideas; the translation of the new idea into marketable products and processes; and the spreading of the new products and processes across the potential market. R&D is used to create new ideas, making it a major input to innovation. Few ideas or inventions actually end up as commercial products or processes for many reasons including availability of financial resources. Committing expenditures to the second and third stages of the innovation process is critical as ideas cannot be commercialized without developing and marketing them. The main aim of innovation is to be the first in the market to reap the rewards. Establishments can reap the full rewards of their innovation by protecting the intellectual property rights of their innovation.

The previous two sections have provided some characteristics of food processing establishments and the competitive environment in which they operate. In this section, inputs and supporting activities to innovation are discussed. These include the extent and nature of R&D investment in the food processing industry, the level of expenditure committed to translating an idea into marketable products and processes, and the activities protecting the intellectual property rights of innovation. This section also assesses the potential relationships between characteristics of establishments and inputs and supporting activities to innovation.

Research and Development (R&D)

R&D is widely used as a measure of a firm's investment in innovation (Morck and Yeung, 2001). West (2000) states that a strong R&D program is often considered a key requirement for a firm wanting to have technological advantage over its competitors. R&D is also a mechanism for technology transfer and an input to innovation. Several other studies have also confirmed the link between R&D investment and innovation. The Conference Board of Canada (2001) reiterates this link by stating that while innovation is known to require much more than just R&D investment,

it is widely acknowledged that R&D is vital for innovation and technological advancement. The Conference Board of Canada further concludes that companies that perform R&D are far more likely to report innovation. Roberts (2001), in an empirical study of top R&D-performing global companies, found a strong correlation between R&D intensity and the percentage of sales from new products as well as between R&D intensity and the overall newness of the firm's technology. R&D is linked indirectly to productivity improvements and increases in standard of living. Bell Canada's submission (2002) to Industry Canada for the Innovation Strategy, notes that R&D leads to innovation, innovation leads to productivity improvements and productivity improvements increase the standard of living. Bell Canada's submission further states that R&D is only a means to an ultimate end. Despite these findings, Canada's private sector underinvests in R&D compared to other developed countries and the R&D spending of business enterprises in Canada is one-third lower than the average for the Organisation for Economic Co-operation and Development (OECD) (Conference Board of Canada, 2001).

The OECD classifies manufacturing industries into four types according to R&D intensity (the percentage of total revenue allocated to R&D). Industries with R&D turnover ratio of more than 5% are considered high-tech industries. Medium high-tech industries are those with an R&D turnover ratio of between 3% and 5%. Medium low-tech industries have between 0.9% and 3% of R&D turnover ratio while industries with R&D turnover ratio of between 0% and 0.9% are considered low-tech industries. Based on this classification and OECD data, the food industry is considered a low-tech industry (Hirsch-Kreinsen et al, 2003). This is also supported by the results reported in Section 2 where R&D intensity is only 0.4%.

Extent and nature of R&D

In this study, research is defined as original investigation undertaken on a systematic basis, by means of experiments and/or analysis to gain knowledge with development defined as the application of research findings or other scientific knowledge for the creation of new products and processes. R&D, as defined in this study, includes prototyping and scale-up but excludes the final commercial production of the new product or the commercial use of the new process.

When Canadian food processing establishments were asked about their R&D activities, 45% reported to have conducted or commissioned R&D during the past three years (Table 19). A greater proportion of these establishments carried out more prototyping and scale-ups than laboratory-based R&D. Out of these R&D-investing establishments, about 68% carried out laboratory-based R&D investigation and 75% carried out prototyping and scale-ups (Table 20). This may indicate that Canadian food processing establishments are generally not at the forefront of laboratory-based R&D but follow-up with some original R&D from other sources.

Of those establishments conducting or commissioning R&D, there are notable differences by size, country of control and industry. As indicated in Table 19, larger-sized establishments or foreign-controlled establishments are more likely to conduct or commission R&D compared to smaller and/or Canadian-controlled establishments. Larger-sized and foreign controlled establishments are also more likely to conduct or commission laboratory-based R&D (Table 20). This is expected as larger-sized establishments are likely to be linked to multinational companies with an incentive to invest in R&D to better compete in foreign markets. However, recent data from Statistics Canada show that Canadian controlled establishments allocate more expenditure to R&D than foreign-controlled establishments (Hassan et al, 2004).

Table 19 shows that fruit, vegetable and specialty food; grain and oilseed; sugar and confectionery; dairy products; poultry processing; and other food have more than 50% of establishments conducting or commissioning R&D. On the other hand, in animal food; meat products; seafood products; and bakeries and tortilla, less than 50% of establishments conducted or commissioned R&D over the past three years.

Table 19: Extent of R&D in food processing industry by size, country of control and industry

	R&D PROGRAM
	% of all establishments
Employment size class	
<20	27.3
20-49	39.3
50-199	54.7
200 and more	62.3
Country of control	
Canada	44.0
US	53.5
Other foreign	51.6
Industry	
Animal food	29.5
Grain and oilseed	58.8
Sugar and confectionery	57.6
Fruit, vegetable and specialty food	62.8
Dairy products	57.6
Meat products	38.0
Poultry processing	59.9
Seafood products	24.9
Bakeries and tortilla	47.7
Other food	59.2
Total food processing	**45.1**

Table 20: Nature of R&D in food processing industry by size, country of control and industry[a]

	LABORATORY-BASED R&D PROGRAM	PROTOTYPE AND SCALE-UPS
	% of establishments that undertook R&D	
Employment size class		
<20	55.0	67.1
20-49	62.0	65.6
50-199	73.0	76.7
200 and more	78.0	91.4
Country of control		
Canada	67.3	74.0
US	75.8	93.4
Other foreign	71.6	63.9
Industry		
Animal food	57.7	51.1
Grain and oilseed	81.3	67.9
Sugar and confectionery	53.6	95.8
Fruit, vegetable and specialty food	69.2	77.1
Dairy products	74.3	67.5
Meat products	74.7	70.7
Poultry processing	67.5	95.6
Seafood products	65.5	66.1
Bakeries and tortilla	64.7	81.4
Other food	72.7	83.9
Total food processing	**68.3**	**75.3**

[a] *Percentages do not add up to 100 due to multiple responses.*

Company's R&D activities

R&D activities of parent companies are also of great importance to establishments not in a position to conduct or commission R&D. As discussed earlier, as many as 50% of food processing establishments are not conducting or commissioning R&D. However, there is a possibility that such establishments are benefiting from the R&D activities of the parent company. Earlier discussions indicated that 43% of establishments have parent companies with production units in several locations. In other words, knowledge and information emanating from R&D activities of a parent company are likely to be diffused or shared among all establishments. This expectation is supported with information from the survey.

When establishments were asked to indicate all the countries or regions in which the parent company has R&D units, the top three locations reported are Canada (37.2% of establishments), the US (12% of establishments) and Europe (6% of establishments). However, as much as 60% of food processing establishments do not know whether the parent companies have laboratory-based R&D units in other locations (Table 21).

Table 21: Location of establishment or parent company's laboratory-based R&D units[a,b]

	LOCATION OF COMPANY'S R&D UNITS						
	Canada	US	Europe	Mexico	Asia	Other	Do not know
	% of establishments that conduct laboratory-based R&D						
Employment size class							
<20	18.7	6.6	1.6	–	0.5	0.5	78.3
20-49	31.6	9.0	4.7	2.2	2.1	2.5	65.3
50-199	42.8	11.1	6.0	1.1	3.6	2.7	55.4
200 and more	64.6	30.4	16.0	6.3	4.6	5.5	29.8
Country of control							
Canada	33.4	4.6	0.9	–	0.6	0.8	66.0
US	71.5	71.6	37.4	12.1	9.7	7.1	11.1
Other foreign	47.6	47.5	47.3	19.8	26.0	27.2	31.2
Industry							
Animal food	22.2	12.2	4.7	–	1.6	0.8	70.0
Grain and oilseed	63.9	47.8	27.1	7.0	6.2	13.9	19.2
Sugar and confectionery	38.8	24.9	13.4	6.1	6.1	3.0	47.9
Fruit, vegetable and specialty food	48.2	19.4	12.0	6.8	3.4	4.6	50.3
Dairy products	56.4	13.4	12.5	2.4	5.1	9.5	41.2
Meat products	35.7	8.5	2.3	–	3.2	0.8	63.5
Poultry processing	51.3	–	–	–	–	–	48.7
Seafood products	13.5	2.0	–	–	–	1.3	85.2
Bakeries and tortilla	32.0	8.2	2.6	0.9	2.5	–	68.0
Other food	62.7	20.9	10.4	5.3	2.6	2.6	35.5
Total food processing	**37.2**	**12.2**	**6.1**	**1.9**	**2.6**	**2.6**	**59.8**

[a] *This represents responses by establishments about their parent companies' R&D activities.*
[b] *Percentages do not add up to 100 due to multiple responses.*
– Not reported.

Companies have different strategies in terms of laboratory-based R&D. Whereas some companies undertake laboratory-based R&D on a continuous basis, others engage in R&D activities occasionally. As indicated in Table 22, over one-third of establishments that conduct laboratory-based R&D reported that their parent companies undertake laboratory based R&D on a continuous basis, whereas 25% indicated that their parent companies occasionally undertake laboratory-based R&D. Foreign-controlled and larger-sized establishments are more likely to undertake laboratory based R&D on a continuous basis than Canadian-controlled and smaller-sized establishments. Foreign-controlled and larger-sized establishments are export-oriented and face more competition in foreign markets. Therefore their strategy to undertake continuous laboratory-based R&D is necessary to gain competitive advantage. With the exception of the seafood products industry, a greater proportion of establishments that conduct laboratory-based R&D reported that their parent companies undertake laboratory-based research on a continuous basis than on occasional basis.

Table 22: Frequency of establishment or parent company's laboratory-based R&D activities[a]

	FREQUENCY	
	Continuously	Occasionally
	% of establishments	
Employment size class		
<20	17.4	19.5
20-49	27.1	25.9
50-199	39.6	27.7
200 and more	58.7	27.9
Country of control		
Canada	27.8	26.3
US	71.9	23.0
Other foreign	73.2	12.7
Industry		
Animal food	29.4	17.2
Grain and oilseed	51.1	40.6
Sugar and confectionery	39.4	29.1
Fruit, vegetable and specialty food	59.8	23.8
Dairy products	48.7	23.4
Meat products	28.6	22.9
Poultry processing	35.3	29.8
Seafood products	7.4	27.8
Bakeries and tortilla	27.3	27.2
Other food	53.3	27.4
Total food processing	**33.7**	**25.4**

[a] *This represents responses by establishments about their parent companies' R&D activities.*

The number of employees involved in R&D activities is an indication of the level of commitment to R&D in a given establishment or company. When establishments were asked to indicate the percentage of employees in the parent company that are engaged in laboratory-based R&D activities, 68% of establishments who conduct R&D indicated that less than 3% of employees in the parent company are engaged in R&D activities. Another 16% reported that between 3% and 10% of employees are engaged in R&D with 5% of establishments also indicating that 11% of the company's employees are engaged in R&D (Table 23).

There are no clear differences among establishments by size, country of control and industry in terms of proportion of employees engaged in R&D activities. In general, a greater percentage of establishments reported that less than 3% of their company's employees are engaged in R&D activities regardless of the size of establishment, country of control and industry. This is consistent with discussions in Section 2, where the number of employees engaged in R&D consistently ranged between 0.5% and 0.8% of total production workers between 1994 and 2002 in the food processing industry (See Table 6).

Table 23: Percentage of establishment or parent company employees engaged in laboratory-based R&D activities[a]

	% OF EMPLOYEES IN LABORATORY-BASED R&D			
	0%	<3%	3-10%	11% or more
	% of establishments			
Employment size class				
<20	22.8	46.8	19.7	10.7
20-49	12.9	61.8	19.7	5.5
50-199	9.4	71.4	15.1	4.0
200 and more	4.8	84.6	8.6	2.0
Country of control				
Canada	12.5	67.0	15.1	5.4
US	5.6	80.9	8.7	4.8
Other foreign	7.3	57.3	35.4	–
Industry				
Animal food	11.9	76.8	11.3	–
Grain and oilseed	9.0	68.7	22.4	–
Sugar and confectionery	8.0	71.7	20.4	–
Fruit, vegetable and specialty food	5.0	61.8	33.2	–
Dairy products	4.9	66.3	20.6	8.2
Meat products	15.6	74.6	4.6	5.2
Poultry processing	12.6	70.3	12.3	4.8
Seafood products	27.1	66.0	2.3	4.6
Bakeries and tortilla	11.5	76.1	11.1	1.3
Other food	8.3	51.1	21.4	19.3
Total food processing	**11.2**	**68.2**	**15.7**	**4.9**

[a] *This represents responses by establishments about their parent companies' R&D activities.*
– Not reported.

Innovation expenditure

Innovation can be costly and the extent of expenditure allocated to innovation may be an indication of the commitment by a given establishment to innovation. Furthermore, establishments will undertake innovative activities only if the anticipated benefits outweigh the cost and risk (West, 2000). Even if the benefits outweigh the cost, the risk may deter risk-averse establishments from allocating more funds to innovation.

When establishments were asked to indicate how much they spent on innovative activities in relation to total gross expenditures on food processing over the last three fiscal years ending in 2003, only 4% of establishments indicated that they spent more than 10% of total gross expenditures on innovation. Just over 60% of establishments spent 5% or less of total expenditure on innovation and about 30% spent nothing at all (Table 24). This supports the analysis in the previous sub-section that food processing is a low-tech industry with low R&D intensity.

Table 24: Creative innovation expenditure as a percent of establishments' annual total gross expenditure by size, country of control and industry

	% OF ANNUAL TOTAL EXPENDITURE FROM CREATIVE INNOVATION				
	None	<1%	1-5%	6-10%	>10%
	% of establishments				
Employment size class					
<20	47.6	24.5	15.6	7.6	4.7
20-49	32.8	24.7	33.5	7.3	1.7
50-199	21.4	33.1	34.8	5.7	5.0
200 and more	10.1	35.8	46.0	4.6	3.5
Country of control					
Canada	30.8	29.0	30.3	6.4	3.5
US	17.7	33.4	34.7	9.3	4.9
Other foreign	14.4	22.9	53.8	3.7	5.2
Industry					
Animal food	33.0	32.0	30.7	1.8	2.5
Grain and oilseed	9.7	46.2	35.9	8.2	–
Sugar and confectionery	21.8	14.5	44.3	9.1	10.3
Fruit, vegetable and specialty food	14.7	35.5	40.1	3.9	5.9
Dairy products	27.9	20.8	38.3	10.7	2.4
Meat products	37.8	26.8	28.1	4.3	3.0
Poultry processing	28.9	13.7	40.8	8.3	8.3
Seafood products	37.6	34.7	21.3	4.0	2.4
Bakeries and tortilla	29.8	30.0	31.2	6.0	3.0
Other food	18.2	27.1	32.1	16.5	6.0
Total food processing	**28.9**	**29.0**	**31.8**	**6.5**	**3.7**

– Not reported.

Large-sized establishments are more likely to invest in innovation than smaller-sized establishments. As indicated in Table 24, only 10% of establishments with 200 or more employees did not allocate funds for innovative activities compared to 48% of establishments with less than 20 employees. Smaller-sized establishments are more likely to be risk-averse than larger establishments. Smaller-sized establishments are also likely to be constrained by financial and human resources limiting their ability to invest more in innovative activities.

The likelihood of allocating expenditure to innovative activities is very much related to R&D activities. Larger-sized and foreign-controlled establishments, which are more likely to undertake R&D on a continuous basis, allocate some amount of manufacturing expenditure to innovative activities (Tables 22 and 24).

Intellectual property

Developing an innovative product or process can be expensive, time consuming and risky and the ability to capture the benefits of an innovation is thus central to the decision to innovate. According to Morck and Yeung (2001), the major cost of creating an innovation is upfront and when an innovative product hits the market, most of its costs are already sunk and the cost of producing an additional unit of the product is typically very small. Intellectual property rights can enhance a firm's ability to capture the expected benefits from innovation and provide economic incentives for innovative activities by prohibiting direct copying without permission (Lesser, 1995). These rights give the innovator a temporary monopoly over the innovation such that the innovator does not have to compete with potential imitators or copiers who do not share the development costs. Many innovators have found themselves forced out of the market because they were unable to appropriate the benefits of their innovative efforts (Laursen and Salter, 2005). The incentive to innovate can therefore be strengthened if establishments can have intellectual property rights to their innovation and such rights can either be protected or enforced by law.

There are several approaches used by establishments and companies to protect innovation or knowledge. Laursen and Salter (2005) developed the concepts of legal and fast mover methods for protecting intellectual property. The legal methods include patents, trademarks, registration of industrial design and copyrights. Examples of fast mover methods include first to the market which gives the innovator a lead-time advantage on competitors; maintaining trade secrets or confidentiality agreements; and the complexity of introducing a product. Lieberman and Montgomery (1998), describe the fast mover methods as relying on silence, complexity of product and quickness. Each of these methods is not without cost and has its own advantages and disadvantages. The costs, the advantages and disadvantages, determine the method of choice for the protection of intellectual property by any given establishment.

When establishments were asked to indicate whether they or their parent companies used any of the above methods to protect the product / process innovations that were introduced over the last three fiscal years ending in 2003, confidentiality agreements or trade secrets; trademark; and lead-time advantage on competitors were the top three methods mentioned. About 41%, 38% and 36% of establishments indicated that their parent companies have protected innovation through confidentiality agreements / trade secrets; trademark; and lead-time advantage on competitors respectively. Copyrights; registration of industrial design and bundling with other products or services are the least likely methods used by Canadian food processing companies to protect their intellectual property rights (Table 25).

Thus fast mover methods, such as trade secrets and lead-time advantage, seem in general to be more popular among Canadian food processing establishments than legal mechanisms, such as patents, registration of industrial design and copyright. This is consistent with other studies in Europe (Harabi, 1995; Arundel and Kabla, 1998; Arundel, 2000). One reason for this is that legal mechanisms can be extremely slow, time consuming and expensive particularly for smaller and medium-sized establishment. It takes several years, for example before a patent can be examined and approved. The time and cost required to enforce a legal mechanism can also be very high and by using legal mechanisms, establishments are also forced to display some of their technology in the public domain (Laursen and Salter (2005).

Table 25: Methods for protecting establishments' innovation

	Registration of industrial design	Trademark	Patent	Confidentiality agreement/trade secrets	Copyright	Lead-time advantage on competitors	Bundling with other products or services
	% of innovating establishments						
Employment size class							
<20	1.8	34.9	6.1	45.8	6.3	24.0	10.2
20-49	4.6	37.0	4.0	36.1	3.3	29.6	6.3
50-199	7.2	29.3	11.4	44.9	1.4	34.9	10.0
200 and more	10.5	60.1	28.2	39.8	4.2	57.1	2.7
Country of control							
Canada	6.3	37.9	8.4	39.2	2.1	36.6	7.2
US	2.6	54.1	37.9	60.8	15.5	38.7	16.5
Other foreign	13.5	22.0	24.4	46.0	–	28.9	–
Industry							
Animal food	7.8	33.8	17.2	37.8	5.3	27.5	23.4
Grain and oilseed	6.2	20.3	7.9	77.6	14.1	44.8	24.5
Sugar and confectionery	–	23.1	24.2	41.8	–	36.3	4.4
Fruit, vegetable and specialty food	3.8	36.2	3.8	55.9	–	35.0	4.6
Dairy products	8.1	55.7	13.5	38.3	2.7	38.9	–
Meat products	18.1	42.0	6.7	34.8	–	45.2	7.0
Poultry processing	6.4	66.5	10.9	17.0	–	43.1	–
Seafood products	11.1	25.6	3.5	28.8	3.5	44.0	–
Bakeries and tortilla	1.7	31.0	15.0	43.4	4.2	30.7	10.0
Other food	2.9	50.5	15.4	43.8	5.5	34.3	2.9
Total food processing	**6.4**	**38.4**	**12.0**	**41.5**	**3.2**	**36.3**	**7.6**

[a] *Percentages do not add up to 100 due to multiple responses.*
– Not reported.

As presented in Table 25 above, there are no specific differences in terms of methods used to protect intellectual property by size, country of control and industry. However, establishments with 200 or more employees are more likely to use lead-time advantage on competitors, trademarks, patents and registration of industrial design than establishments with less than 200 employees

who are more likely to use confidential agreements or trade secrets, bundling with other products or services and copyright. Larger-sized establishments have the resources and ability to develop lead-time advantage over competitors and register trademarks and patents.

Although the number of patents is normally used as an indicator of the extent of innovation, only 12% of establishments indicated the use of patents to protect intellectual property. As discussed above, this is due to the time, effort and cost involved in patenting a product or process and enforcing it. This finding also questions the use of patents as an indicator of innovation since it underestimates the incidence of innovation at least in the food processing industry.

Canadian food processing establishments may apply for Canadian or US patents. As indicated in tables 26 and 27, as many as 90% and 95% of innovating establishments did not apply for either. Only 5% and 2% of innovating establishments applied for more than one Canadian and US patent, respectively.

Table 26: Number of Canadian patents applied for by food processing companies by establishment size, country of control and industry

	None	1	>1
	% of innovating establishments		
Employment size class			
<20	89.4	6.1	4.5
20-49	95.2	3.2	1.6
50-199	90.2	3.7	6.1
200 and more	85.4	5.0	9.6
Country of control			
Canada	94.1	3.7	2.2
US	87.4	3.3	9.3
Other foreign	45.0	12.1	42.9
Industry			
Animal food	87.3	12.7	–
Grain and oilseed	100.0	–	–
Sugar and confectionery	86.8	13.2	–
Fruit, vegetable and specialty food	92.5	–	7.5
Dairy products	81.2	5.4	13.5
Meat products	90.8	2.2	7.0
Poultry processing	94.6	5.4	–
Seafood products	100.0	–	–
Bakeries and tortilla	93.3	–	6.7
Other food	84.2	9.9	5.9
Total food processing	**90.5**	**4.2**	**5.3**

– Not reported.

Table 27: Number of US patents applied for by food processing companies by establishment size, country of control and industry

	None	1-2	>2
	% of innovating establishments		
Employment size class			
<20	95.7	4.3	–
20-49	100.0	–	–
50-199	95.3	2.7	2.0
200 and more	88.9	5.0	6.1
Country of control			
Canada	98.3	1.7	–
US	85.3	4.3	10.4
Other foreign	70.1	12.1	17.8
Industry			
Animal food	100.0	–	–
Grain and oilseed	100.0	–	–
Sugar and confectionery	64.8	13.2	22.0
Fruit, vegetable and specialty food	100.0	–	–
Dairy products	94.6	5.4	–
Meat products	94.9	5.1	–
Poultry processing	100.0	–	–
Seafood products	100.0	–	–
Bakeries and tortilla	95.0	1.6	3.3
Other food	97.1	2.9	–
Total food processing	**95.4**	**2.6**	**2.0**

– Not reported.

Tables 26 and 27 also indicate some differences in patents applied for by size, country of control and industry. For example, as much as 94% of Canadian-controlled innovating establishments did not apply for Canadian patents compared to 87% and 45% of US and foreign-controlled innovating establishments respectively. Also 98% of the Canadian-controlled innovating establishments did not apply for any US patents over the three years ending in 2003 whereas about 15% and 30% of US-controlled and other foreign controlled innovating establishments applied for US patents.

Conclusion

R&D is an important and necessary input for innovation. However, less than half of food processing establishments are engaged in R&D activities and a greater proportion of such establishments are more into prototyping and scale-ups than in laboratory-based R&D activities. There are some notable differences in terms of R&D activities by size of establishment, country of control and industry. Large-sized and foreign-controlled establishments are more likely to conduct or commission R&D and invest in laboratory-based R&D.

Although certain establishments are not engaged in R&D activities, they may benefit from R&D conducted or commissioned by their parent companies. Different companies may have different strategies in R&D. A greater percentage of companies who have an R&D program undertake laboratory-based R&D on a continuous basis compared to those who do this occasionally.

An idea developed through R&D needs to be translated into innovation and this requires financial resources. However, Canadian food processing establishments do not allocate significant funds to innovative activities.

Several approaches are used by establishments to protect intellectual property. Fast mover strategies, such as trade secrets and lead-time advantage, seem in general to be more popular among Canadian food processing establishments than legal mechanisms, such as patents, registration of industrial design and copyright. Patents, which are sometimes used as a measure of innovation, is not a very likely approach to be used by food processing establishments in protecting intellectual property. Only a few Canadian food processing innovating establishments reported applying for patents.

Section 7

Innovation in the food processing industry

Innovation is at the centre of the competitiveness of an establishment, an industry or the whole nation. According to the Conference Board of Canada (1999), companies with high innovation performance are more likely to achieve superior business outcomes. Ehrlich (1999) even goes further by stating that innovations produce economic returns not only for innovators but also for subsequent imitators and for the users of these innovations. An Industry Canada report also reiterates this by stating that the economic success of the developed world has been built upon the ability to generate and harness innovation and wealth by exploiting innovative ideas (Industry Canada, 2002).

Morck and Yeung (2001) reiterate Shumpeter's argument that competition in neoclassical economics takes on a new dimension when one thinks about innovation. Firms compete to innovate as well as to cut prices, and competition to innovate may be more important than competition to cut prices. Morck and Yeung (2001) further state that successful innovation bestows monopoly profits upon the innovator. However, this monopoly is not the same as the ordinary monopoly power where establishments are protected from competitors by permanent barriers to entry. Monopoly from innovation does not harm consumers as they benefit from the improved product or production process and it is also not a permanent phenomenon as adopters or imitators may adopt and compete in the long-run.

Innovation can be defined broadly as a process through which economic value is extracted from knowledge through the generation, development and implementation of ideas to produce new or improved products, processes and services (Conference Board of Canada, 2001). However, innovation has often been associated with inventions and has traditionally being measured by R&D spending, number of scientists educated and employed and number of patents issued (Industry Canada, 2002). Industry Canada (2002) states that R&D and patents are important sources of innovation but they only track one component of innovation and do not track many other equally important areas of innovation such as improved business processes, new business models, new services and creative cultural products. As discussed in the previous section, R&D

is only an input to innovation and does not always translate into innovation. Furthermore, only a small proportion of innovators actually patent their innovation and therefore the number of patents underestimates innovation.

In this report, innovation is classified into product and process innovation. Product innovation is defined as the introduction of any good or service, that's fundamental characteristics or intended uses are new or differ significantly from other products or services offered by the industry in North America. This may involve the development of a brand new product, significant modifications to an existing product or the purchase of the right to produce or copy products that are not currently available for sale in North America. Process innovation includes production techniques, production processes, systems monitoring, and biotechnology processes that are introduced by an establishment and new to the industry in North America.

Innovative activities of establishments are said to grow out of their strategies and practices and directly affects technology use (Baldwin et al. 1999). Baldwin et al (1999), however, noted in their analysis of the Advanced Technology in the Canadian Food Processing Industry Survey, that the emphasis placed on product innovation by Canadian food processing establishments was greater than that on technology use, but that neither was the most important business strategy.

Innovation and related characteristics are expected to be influenced by several factors including the type of industry and the characteristics of the establishments. The type of industry or product will determine the type and speed of innovation. The size of establishment and whether it is a multinational can also determine the drive and ability to innovate. This view is supported by Geroski (1994) who argues that although innovation producing firms perform better than non-innovators, especially during economic downturns, the difference between innovators and non-innovators are due to a firm's characteristics and not to incentives and opportunities.

In the previous section, supporting activities to innovation; R&D, innovation expenditure and intellectual property are discussed. In this section, the extent of both product and process innovation in the food processing industry in Canada are analysed.

Incidence of innovation

When food processing establishments were asked to indicate whether they introduced to the market any product or process innovations, during the last three fiscal years ending in 2003, about 36.8% of establishments responded that they introduced at least one product innovation during the period but only 22.5% of establishments indicated that they introduced at least one process innovation (Table 28). These proportions are comparable to those of Australia. According to the Australian Innovation Survey, 33% and 29.1% of food, beverage and tobacco manufacturing establishments in Australia undertake product and process innovations respectively (Marceau, Wixted and Basri, 2001). One reason for the greater proportion of establishments involved in product innovation than process innovation is that new products are more easily licensed than new processes (West, 2000). Cohen and Klepper (1996) also argue that information asymmetries make it difficult to obtain returns to process innovations other than through own-firm production.

Larger-sized and foreign-controlled establishments are more likely to be engaged in innovation (Table 28). Larger-sized establishments are likely to have the necessary resources and see sufficient benefits to undertake innovative activities (Baldwin et al. 1999). Larger-sized firms can also easily cover the cost of innovation through larger sales, have better sources of financing, and benefit from economies of scale and scope in innovation (West, 2000). As indicated in Table 28,

establishments in fruit, vegetable and specialty food; sugar and confectionery; and bakeries and tortilla are the most likely to undertake product innovation with more than 45% of such establishments indicating the introduction of product innovation into the market over three years ending in 2003. Process innovation is also more likely to be introduced to the market by establishments in sugar and confectionery; fruit, vegetable and specialty food; and grain and oilseed industries. Establishments in seafood products are least likely to innovate with only 15% of establishments reporting the introduction of a product or process innovation into the market over the three-year period ending in 2003. These differences in innovation are reflective of R&D activities discussed in the previous section and support the argument that the level of R&D activity is indicative of the level of innovation.

Table 28: Incidence of innovation in the food processing industry by size, country of control and industry

	PRODUCT INNOVATION	PROCESS INNOVATION
	% of establishments	
Employment size class		
<20	23.0	14.3
20-49	34.2	19.1
50-199	40.7	26.2
200 and more	54.5	33.4
Country of control		
Canada	35.8	22.6
US	42.2	18.8
Other foreign	45.3	25.8
Industry		
Animal food	29.4	12.9
Grain and oilseed	32.2	29.5
Sugar and confectionery	47.3	41.8
Fruit, vegetable and specialty food	54.6	35.8
Dairy products	43.1	27.0
Meat products	31.5	15.4
Poultry processing	43.8	15.4
Seafood products	15.6	15.0
Bakeries and tortilla	45.7	22.8
Other food	42.9	27.8
Total food processing	**36.8**	**22.5**

Number of innovations

In order to understand the extent of innovation, innovating establishments were asked to indicate the number of product or process innovations they introduced into the market over the three year ending in 2003. Table 29 indicates that the majority of establishments who were engaged in innovation introduced less than six product or process innovations over the three year period. Only about 30% and 10% of establishments that were engaged in innovation intro-

duced six or more product and process innovations respectively. This result is consistent with the conclusion of the Conference Board of Canada (2001) that Canadian establishments are more risk-averse and less entrepreneurial and that they report considerably fewer innovations than establishments in other countries. This result also reflects the perception by establishments that frequency of introducing new or improved products is not a major area of high competitive intensity (see Table 18).

There are some differences by size, country of control and industry in terms of number of innovations introduced. Larger-sized establishments are more likely to introduce six or more innovations. Table 29 shows that 38% and 14% of establishments with 200 or more employees introduced six or more product and process innovations respectively.

Table 29: Number of innovations by size, country of control and industry

	NO. OF PRODUCT INNOVATIONS		NO. OF PROCESS INNOVATIONS	
	1-5	6 or more	1-5	6 or more
	% of innovating establishments			
Employment size class				
<20	71.3	28.7	83.8	16.2
20-49	82.5	17.5	93.8	6.2
50-199	65.6	34.4	93.0	7.0
200 and more	61.6	38.4	86.3	13.7
Country of control				
Canada	69.8	30.2	91.1	8.9
US	74.1	25.9	83.7	16.3
Other foreign	72.0	28.0	90.2	9.8
Industry				
Animal food	80.7	19.3	100.0	–
Grain and oilseed	78.4	21.6	88.2	11.8
Sugar and confectionery	71.8	28.2	87.0	13.0
Fruit, vegetable and specialty food	75.7	24.3	93.9	6.1
Dairy products	83.4	16.6	86.9	13.1
Meat products	62.3	37.7	81.4	18.6
Poultry processing	44.5	55.5	80.6	19.4
Seafood products	85.4	14.6	89.2	10.8
Bakeries and tortilla	63.0	37.0	96.9	3.1
Other food	65.9	34.1	90.1	9.9
Total food processing	**70.3**	**29.7**	**90.5**	**9.5**

– Not reported.

Canadian-controlled establishments are also more likely to introduce six or more product innovation whereas there is a higher probability for US-controlled establishments to introduce six or more process innovations. Poultry processing establishments are more likely to introduce six or more product and process innovations, whereas establishments in seafood products manufacturing are less likely to introduce more than six product innovations.

Methods employed in developing innovations

When establishments were asked to indicate the methods most often used to develop innovations, four main methods were mentioned: purchasing the right and being the first to use an equipment, technology or system in North America; copying products, equipments, technologies or processes available elsewhere, other than North America; significantly adapting, improving or modifying existing products, equipments, technologies or systems; and developing completely new products, equipments, technologies or system. Whereas the last three methods are common to both product and process innovations, the first method is more associated to process innovation than to product innovation.

In terms of product innovations, the majority of innovative food processing establishments (55%) develop completely new products (Table 30). Only a few establishments indicated that they either copy products available elsewhere or they significantly adapt, improve or modify existing products. However, in terms of process innovation, innovative food processing establishments are more likely to adapt, improve or modify existing equipment, technologies or systems (Table 31).

Table 30: Methods used by establishments for product innovation

	Copying products available elsewhere, other than North America	Significantly adapting, improving or modifying existing products	Developing completely new products	Other
	% of innovating establishments			
Employment size class				
<20	4.2	4.1	32.1	59.6
20-49	2.4	7.2	57.2	33.2
50-199	1.6	9.4	55.0	34.0
200 and more	1.6	4.0	65.0	29.3
Country of control				
Canada	1.9	6.3	55.6	36.2
US	2.9	–	53.0	44.2
Other foreign	5.8	27.3	42.5	24.4
Industry				
Animal food	5.4	2.7	56.9	35.0
Grain and oilseed	–	8.5	80.1	11.4
Sugar and confectionery	6.4	9.0	51.3	33.3
Fruit, vegetable and specialty food	5.0	–	43.1	51.9
Dairy products	–	15.2	53.7	31.1
Meat products	–	–	70.5	29.5
Poultry processing	–	–	73.8	26.2
Seafood products	5.2	5.2	64.8	24.9
Bakeries and tortilla	1.5	8.7	46.0	43.8
Other food	–	–	70.5	29.5
Total food processing	**2.2**	**7.0**	**54.6**	**36.2**

– Not reported.

Only 13% of establishments indicated that they developed completely new equipments, technologies and systems over the three year period ending in 2003. These findings are consistent with findings from the Survey of Advanced Technology in the Canadian Food Processing Industry in 1999 where product innovators placed the greatest emphasis on the development of new products whereas process innovators placed less emphasis on developing new technologies (West, 2000).

Table 31: Methods used by establishments for process innovation

	Purchasing the right and being the first to use equipments, technologies or systems in North America	Copying equipments, technologies or processes used elsewhere, other than North America	Significantly adapting, improving or modifying existing equipments, technologies or systems	Developing completely new equipments, technologies or systems	Other
	% of innovating establishments				
Employment size class					
<20	3.1	6.9	75.3	14.8	–
20-49	–	6.1	72.8	21.1	–
50-199	9.8	13.5	62.6	12.1	2.0
200 and more	10.0	16.4	68.8	4.8	–
Country of control					
Canada	6.6	11.0	67.6	13.9	0.9
US	8.3	16.2	75.5	–	–
Other foreign	–	9.8	70.1	20.1	–
Industry					
Animal food	–	22.4	64.3	13.3	–
Grain and oilseed	9.3	11.8	78.9	–	–
Sugar and confectionery	–	–	71.1	28.9	–
Fruit, vegetable and specialty food	6.8	14.5	60.1	12.5	6.1
Dairy products	9.9	9.9	65.9	14.3	–
Meat products	4.5	26.0	58.3	11.2	–
Poultry processing	11.5	19.4	59.4	9.7	–
Seafood products	4.9	5.4	84.3	5.4	–
Bakeries and tortilla	3.8	7.2	76.7	12.3	–
Other food	14.6	5.0	61.0	19.5	–
Total food processing	**6.4**	**11.3**	**68.3**	**13.2**	**0.8**

– Not reported.

There are a few notable differences across establishments by size, country of control and industry. The larger the establishment, the more likely, it is to develop completely new products but the least likely it is to develop a completely new equipment, technology or system. According to Table 30, 65% of establishments with 200 or more employees developed completely new products in the three-year period ending in 2003 compared to 32% of establishments with less than 20

employees. Larger-sized establishments are also those establishments that continuously undertake R&D and have the expertise and financial resources with the capacity to spread risk. It also reflects findings in Section 5, where a greater proportion of establishments with 200 or more employees relative to other establishments, indicated that frequently introducing new or improved products is a factor of high competitive intensity. Regarding process innovation, only 5% of establishments with 200 or more employees compared to 15% of establishments with less than 20 employees developed completely new equipments, technologies or systems. This is likely because larger-sized establishments are likely to copy, significantly adapt, improve or modify technologies developed by another R&D unit of parent company.

Canadian-controlled establishments are more likely to develop completely new products but less likely to develop completely new equipments, technologies or systems than other foreign-controlled establishments. US controlled establishments are least likely to develop completely new equipments, technologies or systems. Other foreign-controlled and US-controlled establishments are more likely to copy or significantly adapt, improve or modify existing product and process respectively. Foreign-controlled establishments are likely to be associated with multinational companies and therefore have easier access to products and technologies developed and tried elsewhere by their parent companies making it cost effective to copy or adapt rather than to develop a completely new product or process. As indicated earlier, foreign-controlled establishments have parent companies with relatively large number of R&D units in several locations (Table 21).

Strategies employed in developing new products

Product innovation can be developed using several strategies. R&D investigation can be undertaken either by the establishment, the parent company outside the establishment or contracted out to other firms. Prototyping and scale-ups and similar engineering services provided by the establishment can also be employed. Establishments can also collaborate with other establishments or firms in the agri-food chain or with packaging or equipment suppliers. Another strategy can be licensing or copying of products offered outside North America, licensing and copying equipment / technology / system used by the industry outside North America or by other industries.

When establishments were asked to indicate which strategy they used in developing their most recently introduced products, the top two strategies are identified as laboratory-based R&D activity by establishment; and prototyping, scale-ups and other similar engineering services provided by establishment. This result is similar to those obtained by West (2000). About 43% of innovating establishments indicated that they introduced their most recent product innovation through laboratory-based R&D investigation in the establishment and 36% of establishments used prototyping, scale-ups and other similar engineering services provided by the establishment. Some establishments (22%) also indicated using R&D investigation by the parent company outside the establishment. Other establishments either collaborate with packaging and equipment suppliers (18%) or with other establishments in the agri-food chain (18%) (Table 32). The least likely strategy is licensing or copying products from outside North America with only 2% of establishments using this strategy (Table 32).

The results confirm the importance of R&D in the innovation process and also indicate that establishments prefer to develop products internally instead of contracting to other firms. In this way, establishments can have full control of the innovation and can appropriate full benefits from the innovation before their competitors. The findings that licensing and copying is the least

likely strategy for developing product innovation is consistent with results in the previous section where copying of products is the least likely method for introducing product innovation (Table 30).

Table 32: Strategies for developing the most recently introduced innovation[a]

	PRODUCT INNOVATION	PROCESS INNOVATION
	% of innovating establishments	
Laboratory-based R&D investigation		
In establishment	42.5	32.8
By parent company outside establishment	22.2	6.8
Contracted out to other firms	5.2	11.1
Using prototyping scale-ups and similar engineering services provided by the establ.	36.1	36.5
Collaborating with:		
Other firms/establishments up and down the agri-food chain	17.8	15.8
Packaging and equipment suppliers	18.1	41.1
Licensing/copying		
Products offered outside North America	2.3	n/a
Equipment/technology/system used by your industry outside North America	n/a	3.3
Equipment/technology/system used by other industries but not in your own industry	n/a	0.5
Other	**2.3**	**0.5**

[a] *Percentages do not add up to 100 due to multiple responses.*

In terms of process innovation, collaborating with packaging and equipment suppliers and prototyping and scale-ups are the most likely strategies employed by establishments for their most recently introduced process innovation. About 41% of establishments indicated collaborating with packaging and equipment suppliers with 36% of establishments reported prototyping, scale-ups and similar engineering services provided by establishment. The least likely strategy for process innovation is licensing or coping equipment, technology or system with only 3% of establishments reporting licensing and coping equipment, technology or systems used by industry outside North America and another 0.5% indicating licensing or copying equipment, technology or system from other industries (Table 32).

Objectives and impacts of innovation

Establishments undertake innovation with a specific or combination of objectives in mind. These objectives can be in the broader areas of product expansion, market expansion or product characteristics. Under product expansion, an establishment or company may have the objective of replacing products being phased out, adding new products to the existing lines of products, creating superior products and branding. An establishment can also have several objectives under market expansion including opening up new domestic markets, opening up new foreign markets, and increasing market share in existing markets. An establishment may also innovate with the objective of improving food safety, reducing negative environmental impacts and meeting buyers' standards or requirements. When establishments were asked to indicate their main objectives for their most recently introduced product innovation, the top three objectives were adding new products to the existing lines of products, increasing market share and meeting buyers' standards or requirements (Table 33).

Table 33: Main objectives for establishments' most recently introduced product innovation

	% of innovating establishments
Product expansion	
Replace product(s) being phased out	2.8
Add new product to your existing lines of products	61.2
Create superior product differentiation and branding	34.8
Not applicable	1.1
Market expansion	
Open up new domestic markets	26.9
Open up new foreign markets	11.8
Increase market share	57.1
Not applicable	4.3
Product characteristics	
Improve food safety aspects	13.9
Reduce negative environmental impacts (e.g., choice of packaging)	2.7
Meet buyer's standards/requirements	57.9
Not applicable	25.5

When establishments were asked to rate the impacts of their most recently introduced process innovation, several areas were mentioned as being impacted including improvements in production flexibility; productivity improvements or reductions in cost of production; ability to produce a new product; ability to meet buyers' requirements or standards; improvements in product safety, quality and consistency; and ability to comply with environmental standards or regulations. According to Table 34, process innovation is reported to have the most impact on improving productivity or reducing production cost. About 75% of establishments indicated that their most recently introduced process innovation had a moderate or major impact on improving productivity or reducing their cost of production. Other areas most impacted by process innovation are improved product safety or quality and ability to produce new products. Improving their ability to comply with environmental standards or regulations is an area with the least impact with 34% of innovating establishments indicating moderate or major impact. This area is also the lowest ranked objective for establishments' most recently introduced product innovation (Table 33).

Table 34: Impacts of most recently introduced process innovation in the food processing industry

AREA	NO IMPACT	MINOR	MODERATE	MAJOR
	% of innovating establishments			
Improving production flexibility	6.8	19.1	31.2	29.3
Improving productivity/reducing cost of production	4.7	13.6	29.2	45.4
Creating ability to produce a new product	10.1	19.8	23.7	37.3
Improving ability to comply with buyer's requirements/standards	13.0	21.2	30.2	26.2
Improving product safety/quality/consistency	7.0	16.6	30.2	37.4
Improving ability to comply with environm. standards/regulations	14.5	26.5	14.7	19.5

Returns to innovation

As discussed earlier in this section, innovation produces economic returns to innovators. Establishments will innovate with the ultimate aim of improving efficiency and productivity and maximising profits. When establishments were asked to indicate what percent of their annual total sales from food production came from product innovations introduced during the three-year period ending in 2003, about 61% of innovating establishments indicated less than 10% on average with 16% of innovating establishments indicating 20% or more of total annual sales (Table 35).

Table 35: Sales from product innovations as a percent of establishments' annual total sales by size, country of control and industry

	% OF ANNUAL TOTAL SALES FROM PRODUCT INNOVATION			
	<10%	10-19%	20-49%	50% and more
	% of innovating establishments			
Employment size class				
<20	48.9	26.4	12.4	12.3
20-49	60.3	23.8	10.4	5.6
50-199	54.8	26.8	13.4	5.1
200 and more	79.6	14.9	2.0	3.5
Country of control				
Canada	61.0	22.7	10.2	6.1
US	61.6	23.3	11.6	3.6
Other foreign	56.2	33.6	4.8	5.3
Industry				
Animal food	60.5	33.7	5.8	–
Grain and oilseed	80.7	8.5	10.8	–
Sugar and confectionery	53.9	34.6	5.1	6.4
Fruit, vegetable and specialty food	64.0	13.0	13.2	9.9
Dairy products	65.5	17.3	8.3	9.0
Meat products	68.4	15.8	8.3	7.4
Poultry processing	73.8	14.4	5.7	6.1
Seafood products	79.8	15.0	–	5.2
Bakeries and tortilla	45.1	33.6	18.2	3.1
Other food	58.2	25.7	6.4	9.6
Total food processing	**60.8**	**23.4**	**10.0**	**5.9**

– Not reported.

As shown in Table 35, smaller-sized establishments report a greater percentage of total sales from product innovations. Canadian-controlled establishments are more likely to benefit from innovation with a relatively greater proportion (16.3%) reporting more than 20% of annual total sales from product innovation (Table 35). However, this is just related to size as Canadian-controlled establishments are more likely to be smaller in size than foreign-controlled establish-

ments. Although establishments in grain and oilseed are more likely to develop completely new products, they are less likely to have more than 20% of total annual sales from product innovation. On the other hand, bakeries and tortilla establishments are more likely to have more than 20% of their sales from product innovation, although they are less likely to develop completely new products. However, these differences might be related more to size than industry type.

Conclusion

It can be concluded from the above discussions that the incidence of innovation in the Canadian food processing industry is low, with a greater number of establishments involved in product innovation than in process innovation. Furthermore only a few innovating establishments introduced more than five innovations over the three-year period ending in 2003.

Larger-sized and foreign-controlled establishments are also more likely to innovate than Canadian-controlled and smaller-sized establishments. Canadian-controlled establishments are more likely to introduce six or more product innovations but less likely to introduce six or more process innovations.

Canadian food processing establishments are more likely to develop completely new products using laboratory-based R&D investigation in establishments.

In terms of process innovation, Canadian food processing establishments are more likely to significantly adapt, improve or modify existing equipment, technology and systems through collaboration with packaging and equipment suppliers. Canadian-controlled establishments are less likely to develop completely new processes. On the other hand, foreign-controlled establishments are more likely to copy or significantly adapt, improve or modify existing product or process.

Establishments also innovate with a specific or combination of objectives in mind with the top three objectives including adding new products to the existing lines of products, increasing market share, and meeting buyers' standards or requirements. Process innovation is also said to impact several areas with improved productivity or reduced production cost as the area of greatest impact.

Finally, for most of the Canadian food processing establishments, sales from product innovation is less than 10% of total annuals sales on average.

Section 8

Obstacles to innovation

In this survey, we have identified three main factors hindering innovation: financial impediments, impediments internal to the establishment, and impediments external to the establishment. This section discusses these obstacles.

Financing is a key factor for the successful commercialization of innovations. Establishments need to have enough cash flow to innovate or look elsewhere for equity funding and debt financing. Morck and Yeung (2001), state that cash flow from past innovation can be used by firms to finance further innovation. In general, there is lack of seed money to finance business start-ups and product development. Venture capital firms generally invest much later in promising companies which have developed well defined product specifications or processes. 'Angel' investors (individuals who provide seed money for start-ups) tend to invest in earlier stages. However, there are not enough of these angel investors. Therefore, there may be a role for government to participate in the seed or pre-venture stage.

Factors internal to establishments such as corporate or management capabilities, resistance to innovation and lack of an idea champion may also hinder the innovative process. According to West (2000), successful innovation requires the capacity of the firm to make an accurate assessment of benefits and costs, and to carry out development, acquisition and implementation activities appropriately. This also implies a strong commitment of resources and a willingness to accept risk. Management's inability or unwillingness to commit resources to innovation or take risk hinders the innovation process. According to the Conference Board of Canada (2001), innovations flourish in organisations where entrepreneurial and risk-taking is encouraged and celebrated, and management's passion for innovation makes a difference in a company's innovation performance. However, a Conference Board of Canada's leadership survey shows that most Canadian managers are not committed to highly intensive innovation (Conference Board of Canada, 2001).

Factors external to the establishment that may hinder innovation include availability of skilled workers, government regulations or standards, lack of retail acceptance or access to distribution channels, and intellectual property rights. Becker (1962) regards human capital as a critical input to innovation. Roy (1997) also provides evidence of the importance of human capital as a deter-

minant of innovation and economic growth and argues that the optimal policy might be to over-invest in human capital. Morck and Yeung (2001), concludes that human capital, as measured by educational achievement, appears to determine the pace of innovation of an economy. Conference Board of Canada (2001) argues that firms that are highly innovative put a premium on attracting and retaining a diversity of people with complementary competencies that ensure the creation of ideas and successful implementation of those ideas. However, the same report ranks Canada among the lowest developed countries in terms of literacy levels of its workforce, limiting its innovation and productivity.

Government regulation is another external factor that may impact innovation. Establishments must meet environmental, food safety, plant hygiene and labour standards and regulations. Monetary and fiscal policies also affect innovation (Morck and Yeung, 2001). Regulations have to be flexible in order to support innovation and not to hamper it. In some instances, government regulations may have the effect of increasing costs; whereas in other cases, innovation may help establishments in the food processing industry better meet regulatory requirements, which could result in differentiating and branding their products. For example, the use of Hazard Analysis Critical Control Point (HACCP) helps many food processing establishments meet international standards on food safety.

Retail acceptance and access to distribution channels are also important for innovation. A product innovation can not be successful if it is not accepted by retailers and cannot be marketed. The fear of a new product not being accepted by retailers and supported by the distribution channels may be a disincentive to potential innovators.

Intellectual property rights can also impact innovation. Establishments need to appropriate benefits from their innovative efforts. Morck and Yeung (2001) argue, innovation is based on information, and the information has unique properties that cause market solutions to be non optimal in many cases, suggests a possible role for government in innovation. The government's main role here is to develop laws or rules that will enable innovators to protect their intellectual property rights.

Factors impeding innovation

When Canadian food processing establishments were asked to rate the impacts of the previously-mentioned factors regarding their ability to innovate, the single most important impeding factor mentioned by 42% of innovating establishments to have a medium or high negative impact on innovation was lack of internally generated cash flow (Table 36). Innovation requires significant cash flow for development and marketing.

The least likely factor to impede innovation is the difficulty in negotiating clear intellectual property rights (Table 36). Intellectual property rights is not a major impeding factor because establishments have several mechanisms for protecting the rights to their innovation such as trade secrets.

Table 36: Importance of obstacles to innovation

FACTOR	LOW	MEDIUM	HIGH
	% of innovating establishments		
Financial			
Lack of internally generated cash flow	35.0	20.0	22.2
Lack of external equity funding	29.0	13.3	12.7
Lack of debt financing	38.8	16.1	9.1
Long gestation period of innovation	32.9	26.6	10.8
Internal			
Lack of marketing capability	43.6	26.0	10.3
Corporate/management resistance to innovation	56.8	9.6	6.2
Lack of idea champions	53.4	18.2	5.9
External			
Shortages of skilled workers	43.5	21.4	15.7
Insufficient flexibility in regulations or standards	39.5	24.1	13.2
Difficulty in negotiating clear intellectual property (IP) rights	43.8	5.7	3.6
Lack of retail acceptance or access to distribution channels	42.4	16.1	13.0

Impediments to innovation vary by establishment size, country of control and industry (Tables 37, 38, 39). The negative effects of factors to innovation are likely to be less for larger-sized and foreign controlled establishments than for smaller-sized and Canadian-controlled establishments.

Table 37: Importance of obstacles to innovation by establishment size

FACTOR	<20	20-49	50-199	200+
	% of innovating establishments reporting factor with medium or high importance			
Financial				
Lack of internally generated cash flow	50.1	54.7	37.1	29.0
Lack of external equity funding	38.1	36.2	19.2	16.5
Lack of debt financing	24.3	38.7	21.0	15.0
Long gestation period of innovation	40.1	47.5	34.0	27.8
Internal				
Lack of marketing capability	45.3	40.1	34.2	28.7
Corporate/management resistance to innovation	15.7	13.6	13.3	23.6
Lack of idea champions	17.2	27.2	24.8	23.2
External				
Shortages of skilled workers	34.9	46.1	37.4	25.1
Insufficient flexibility in regulations or standards	42.0	32.2	42.6	31.2
Difficulty in negotiating clear intellectual property (IP) rights	8.3	10.7	10.8	5.4
Lack of retail acceptance or access to distribution channels	28.6	36.0	32.2	13.4

However, larger-sized establishments are more likely to have management resistance to innovation. Such establishments are more likely to perform better in the market place and management could be hesitant to innovate since it may risk their economic performance. Innovating establishments with 50-199 employees are more likely to be affected by insufficient flexibility in regulations or standards. Innovating establishments with less than 50 employees are more likely to face financial impediments to their innovative efforts such as lack of internally generated cash flow, lack of debt financing and long gestation periods of innovation.

Table 38: Importance of obstacles to innovation by country of control

FACTOR	CANADA	US	OTHER
	% of innovating establishments reporting factor with medium or high importance		
Financial			
Lack of internally generated cash flow	44.8	39.7	10.1
Lack of external equity funding	29.0	12.5	4.4
Lack of debt financing	28.0	10.7	8.5
Long gestation period of innovation	36.4	50.1	33.2
Internal			
Lack of marketing capability	37.3	27.4	34.6
Corporate/management resistance to innovation	16.9	13.2	4.1
Lack of idea champions	23.9	24.3	27.5
External			
Shortages of skilled workers	40.2	10.8	30.5
Insufficient flexibility in regulations or standards	38.7	26.3	33.0
Difficulty in negotiating clear intellectual property (IP) rights	9.5	8.0	9.2
Lack of retail acceptance or access to distribution channels	31.4	14.5	16.7

Canadian-controlled establishments are more likely to have most of the financial, internal and external factors impeding their innovative efforts. Canadian-controlled establishments are relatively smaller in size than foreign-controlled establishments. US-controlled establishments are more likely to be affected by long gestation period (Table 38). These establishments generally have the capacity to internally generate cash flow for innovation but more concerned about the time it takes to reap benefits.

Innovating establishments in the seafood products industry are most likely to be impeded by lack of internally generated cash flow, lack of external equity funding and shortage of skilled workers (Table 39). Most of the establishments in the seafood products industry are Canadian-controlled (Figure 5). Innovating establishments in the sugar and confectionery industry have a higher probability of being impeded by a long gestation period and lack of idea champions. A relatively higher percent of establishments in this industry are foreign controlled. Innovating establishments in the dairy products industry are most likely to be impeded by lack of marketing capability, insufficient flexibility in regulations or standards and lack of retail acceptance or access to distribution channels (Table 39). Whereas difficulty in negotiating intellectual property rights is the least likely impediment to innovation for establishments in almost all industries, it is one of the most important factors likely to negatively impact innovation in the grain and oilseed industry (Table 39).

Table 39: Importance of obstacles to innovation by industry

FACTOR	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of innovating establishments reporting factor with medium or high importance									
Financial										
Lack of internally generated cash flow	43.6	12.4	35.1	36.4	38.2	40.3	39.6	52.2	47.9	49.4
Lack of external equity funding (including venture capital)	21.0	–	30.7	16.1	19.4	21.6	28.1	37.0	33.4	35.0
Lack of debt financing	31.3	–	21.9	18.7	24.8	18.4	27.5	29.4	29.6	32.1
Long gestation period of innovation	47.2	32.8	53.8	26.7	49.7	25.6	28.5	37.7	32.9	48.4
Internal										
Lack of marketing capability	22.6	30.7	43.9	27.9	58.4	18.3	38.7	37.7	44.5	35.8
Corporate/management resistance to innovation	13.2	7.9	18.7	10.3	16.1	17.7	50.5	15.2	11.9	15.8
Lack of idea champions	16.8	12.4	39.6	29.5	24.1	24.7	10.6	26.3	23.4	27.0
External										
Shortages of skilled workers	23.1	14.1	48.3	27.9	38.2	46.8	22.4	51.9	43.7	31.9
Insufficient flexibility in regulations or standards	35.4	24.5	26.3	41.8	64.5	45.1	34.2	41.8	28.8	25.9
Difficulty in negotiating clear intellectual property (IP) rights	2.5	32.8	18.7	14.9	8.1	4.4	12.8	19.0	3.1	8.8
Lack of retail acceptance or access to distribution channels	9.4	32.8	18.7	34.6	48.3	36.8	18.2	30.4	27.3	26.1

– *Not reported.*

Accessing capital for innovation

As discussed previously, one of the most likely factors impeding innovation is lack of internally generated cash flow. Establishments with insufficient internal cash flow can acquire capital from external sources for their innovative activities. Almost 28% of innovating establishments indicated that they or their parent companies attempted to raise capital for innovation in the three-year period ending in 2003 (Table 40). This is a very small number and indicates that a significant number of innovating establishments depend on internally generated cash flow for their innovative activities. However, there is no indication from the survey that such internally generated cash flow was sufficient for establishments' innovative activities.

Table 40: Obstacles to capital acquisition for innovation

	% of innovating establishments
Innovating companies attempting to raise capital for innovation	27.6
Innovating companies successful in reaching target funds for innovation[a]	68.2

[a] *This is percentage of establishments who reported that parent company attempted to raise capital.*

External sources of funding included venture capital; angel investment or investment from family and friends; initial public offering (IPO); post IPO stock issues; joint ventures; banks, cooperatives and credit unions; and government sources. The three main sources of funding are banks, cooperatives and credit unions; Canadian-based venture capital and government. About 42% of innovating establishments who attempted to raise capital for innovation went to banks, cooperatives and credit unions. Another 18% and 16% depended on Canadian-based venture capital and government, respectively for innovation funding (Table 41).

Table 41: Main source of funding for innovation

MAIN SOURCE OF RAISED CAPITAL	% of innovating establishments
Canadian based venture capital	17.8%
Foreign based venture capital	–
Angel investors/family/friends	–
Initial public offering (IPO)	–
Joint venture	–
Banks, cooperatives and credit unions	42.1%
Government sources	16.0%

- *Not reported.*

Not all companies were successful in acquiring capital from external sources. About 68% of innovating establishments or their parent companies that attempted to raise capital indicated success in reaching their target funds. Thus, the remaining 32% of innovating establishments or their parent companies were either limited or refused request for innovation funds (Table 40).

There are several reasons given by lenders in refusing or limiting innovating food processing establishments or companies from reaching their target funds for innovation: unavailability of capital due to market conditions; further development or proof of concept required; lender not funding development projects; failure to meet lending criteria; and lack of evidence to support projections. The most common reason given by lenders for refusing or limiting funds for innovation was establishments' inability to meet lending criteria. Almost 40% of those innovating estab-

lishments or their parent companies, who were not successful in raising funds for innovation, were refused because they failed to meet lending criteria. The least likely reason for lenders refusing or limiting company's funding request is the requirement for further development and proof of the innovation concept (Table 42).

Table 42: Main reasons for refusing or limiting company's funding request for innovation by lender

REASON	Percentage (%)
Capital not available due to market conditions	23.0
Further development or proof of concept required	–
Lender does not fund development projects	22.7
Failed to meet lending criteria	39.3
Lack of evidence to support projections	–
Other	39.2

- *Not available.*

Conclusion

Several factors are identified as impediments to innovation with the top factors including lack of internally generated cash flow and a long gestation period of innovation. The factor which is considered to be the least likely to impede innovation is difficulty in negotiating intellectual property rights. There are variations by size, country of control and industry.

Establishments or companies that do not have enough internal cash flow for innovation depend on external funding sources. However, not all of them are successful. About one-third of those establishments or companies attempting to raise funds from external sources were either refused or limited from the target funds required for innovation. The three main sources of funding are banks, cooperatives and credit unions; Canadian-based venture capital; and government. Lenders gave several reasons for this refusal or limitation to funds with the most likely reason given as not meeting the lending criteria and the least likely reason being the need for further development and proof of innovation idea.

Section 9

Collaborative arrangements and linkages

Collaborative efforts between firms, governments and academic institutions enhance Canada's ability to foster growth of innovative enterprises. For example, establishments can cooperate on the development of product and process innovation with raw agricultural product suppliers or organisations, food ingredient suppliers, equipment suppliers, packaging suppliers, food retailers or wholesalers, and foodservice operators, private consultants, commercial laboratories or R&D enterprises, public institutions such as universities or colleges and government research facilities, private research institutes, and competitors. Such collaboration between food processing establishments and stakeholders in the industry for product and process innovations is discussed in this section.

Innovation can be a complex process from the idea phase through successful commercialization. Collaborative strategies for innovative activities may therefore be necessary because of certain competencies and skills required throughout the innovative process. Innovation may require firms to possess a combination of capabilities and resources, which a single organisation may not possess and may involve a prohibitive cost to acquire. Different firms have different skill sets and individual organisations are limited in what they know how to do well (Hobbs and Young, 2001). Firms are always trying to maximise the outputs of their own capabilities or alternatively expand those capabilities through cooperation and alliances. Gow et al. (2002) argue that when shifts in the business environment occur, it becomes imperative that firms are not only able to use their existing core competencies but are also able to develop and leverage new competencies to move quickly and efficiently in response to these changes. Collaboration and support from external sources may therefore be required. West (2000), states that firms make extensive use of external sources of expertise in the innovation process and therefore lack of technical support from suppliers or a lack of access to consultants and professional services offering technical advice, testing and standards would be impediments to innovation for many firms or establishments. Innovation in the design of a modern airplane, for instance, may require about 100 technical specialists and this requires participation and collaboration from a range of companies

(Rycroft and Cash, 1999). Collaboration with other establishments who have the competencies and skill sets required can therefore be an effective strategy for establishments' innovative efforts.

According to the Conference Board of Canada (2001), Canadian companies have a good record of technological collaborations and lead in the category of international technology partnerships among their comparators. Conference Board of Canada (2001), further states that in terms of domestic technology partnerships, Canadian firms compare favourably among their G7 counterparts.

Collaboration partners for innovation

When innovating establishments were asked to indicate the different groups that they or their parent company has worked with over the past three fiscal years ending in 2003 to develop product innovation, 40% indicated collaborating with food ingredient suppliers (Table 43). The second most likely group which collaborated with food processing companies for product innovation is packaging suppliers. The least likely groups to collaborate with include private research institutions, competitors and government research facilities.

Table 43: Extent of collaboration for creative innovation in the food processing industry[a]

	PRODUCT INNOVATION	PROCESS INNOVATION
PARTNER GROUP	% of innovating establishments	
Raw agricultural product suppliers/organizations	22.4	9.4
Food ingredient suppliers	40.2	13.6
Equipment suppliers	20.2	37.3
Packaging suppliers	26.5	22.7
Food retailers/wholesalers	22.0	5.2
Foodservice operators	14.0	3.3
Competitors	4.7	2.7
Consultants	16.5	17.5
Commercial laboratories or R&D enterprises	14.6	7.0
Universities and colleges	12.0	5.7
Federal/provincial government research facilities	8.4	4.9
Private research institutions	3.8	1.9
None of the above	1.7	1.4

[a] *Percentages do not add up to 100 due to multiple responses.*

In terms of process innovation, the most likely group that food processing establishments or their parent companies will collaborate with are the equipment suppliers. Thirty-seven percent of innovation establishments indicated that they or their parent companies collaborate with equipment suppliers (Table 43). This is consistent with results that show that significantly adapting, improving or modifying an existing equipment, technology or system is the most likely method used to introduce process innovation (Table 31). To do this effectively may require linkage or collaboration with equipment suppliers who have the know-how of new and appropriate equipments or technologies. Packaging suppliers are the second most likely group that establishments collaborate with for process innovation. The result is consistent with strategies for devel-

oping most recently introduced process innovation, where most innovating establishments indicated collaboration with packaging and equipment suppliers (Table 32). Private research institutions, competitors and food service operators are the least likely group for innovating establishments to collaborate with in developing process innovation.

There are minor differences across industries, in terms of collaboration partners. Innovating establishments in most industries collaborate with food ingredient suppliers for product innovation. The only exceptions are in the animal food, grain and oilseed, and seafood products industries. Establishments in animal food are more likely to collaborate with raw agricultural product suppliers or organisation. Innovating seafood products establishments are also more likely to collaborate with packaging suppliers whereas grain and oilseed establishments collaborate more with universities and colleges (Table 44).

While equipment suppliers are the most likely collaborators with establishments from all industries in process innovation, there are minor differences between industries in terms of the second most likely partner for collaboration in process innovations. Whereas establishments in most of the industries reported packaging suppliers as their second most likely group for collaboration in process innovation, consultants are the second most likely group to collaborate with establishments in the animal food and grain and oilseed industries (Table 45).

Conclusion

Collaboration is necessary for many food processing establishments to innovate because of certain competencies and skills required throughout the innovative process and the cost involved. Most innovating establishments in the food processing industry collaborate with food ingredient suppliers and packaging suppliers for product innovation whereas for process innovation, establishments collaborate with equipment suppliers and packaging suppliers. Private research institutions, competitors, government and academic institutions are among the least likely groups for food processing establishments to collaborate with in developing innovations.

Table 44: Extent of collaboration for product innovation in food processing by industry

PARTNER GROUPS	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of innovating establishments									
Raw agricultural product suppliers/organizations	34.4	30.4	9.7	23.3	21.7	25.3	16.9	11.7	23.9	20.1
Food ingredient suppliers	30.2	29.3	50.3	41.7	46.6	41.0	60.4	15.1	52.4	50.9
Equipment suppliers	18.5	18.7	26.1	25.5	22.3	21.1	19.1	16.8	17.3	23.7
Packaging suppliers	15.0	17.9	30.3	39.8	24.7	31.1	35.8	24.7	24.6	30.4
Food retailers/wholesalers	7.1	16.7	22.4	28.5	24.3	24.6	46.9	15.4	22.3	30.9
Foodservice operators	3.3	9.7	2.4	19.7	14.5	18.8	17.8	10.5	13.5	27.6
Competitors	4.0	2.7	–	1.5	4.7	2.5	–	6.9	6.6	9.3
Consultants	23.3	13.2	13.9	15.9	32.4	10.6	5.7	12.2	11.8	23.7
Commercial laboratories or R&D enterprises	15.7	23.8	18.2	12.5	18.7	12.4	10.2	13.1	10.9	20.5
Universities and colleges	16.6	31.0	8.5	6.4	22.6	7.6	13.7	11.5	7.0	10.8
Federal/provincial government research facilities	6.1	18.7	–	7.4	21.4	8.7	8.0	5.6	6.1	7.3
Private research institutions	7.2	7.0	5.5	4.9	1.2	4.3	0.0	3.1	2.1	4.6

[a] *Percentages do not add up to 100 due to multiple responses.*

– *Not reported.*

Table 45: Extent of collaboration for process innovation in the food processing by industry[a]

PARTNER GROUPS	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of innovating establishments									
Raw agricultural product suppliers/organizations	11.7	12.6	2.4	9.5	10.7	10.1	10.5	8.9	9.0	6.8
Food ingredient suppliers	13.5	16.1	10.3	13.3	19.3	16.0	10.4	4.8	14.4	19.5
Equipment suppliers	22.0	51.5	50.3	41.2	38.9	39.3	35.6	33.2	37.5	46.9
Packaging suppliers	8.0	21.4	37.0	26.3	25.5	21.9	24.0	25.1	20.7	32.6
Food retailers/wholesalers	4.8	9.7	3.0	3.4	5.9	5.4	0.0	6.4	4.7	6.8
Foodservice operators	2.6	2.7	0.0	4.6	3.6	4.7	0.0	2.3	2.4	6.8
Competitors	4.2	0.0	2.4	0.0	2.4	0.0	0.0	4.0	3.8	6.0
Consultants	15.1	34.6	29.1	16.2	25.5	13.5	10.4	12.7	15.0	24.4
Commercial laboratories or R&D enterprises	8.0	14.1	7.3	6.6	7.1	5.3	0.0	7.6	5.3	10.6
Universities and colleges	5.9	16.9	5.5	5.4	14.3	5.7	5.3	6.3	–	4.0
Federal/provincial government research facilities	2.7	13.4	–	4.9	13.1	3.2	2.7	5.6	3.0	5.1
Private research institutions	3.4	–	–	4.9	2.4	0.8	–	2.4	1.4	1.4

[a] *Percentages do not add up to 100 due to multiple responses.*

– *Not reported.*

Section 10

Government support

In Section 8, several obstacles to innovation are identified. The previous section also discusses collaborative efforts by establishments to overcome some of the obstacles to innovation. Government support may be required if establishments are to overcome the obstacles and be successful in their innovative efforts. In this section, therefore a discussion of the importance of government support is provided.

In a free market environment, consumer demand and supply of different inputs determine the course and speed of innovation (Koppel, 1995). However, this assumes that the free market can effectively allocate resources to innovation. The potential for market failure in a free market environment implies that allocation of funds to innovative activities may not be efficient or effective. For example, the development of new product or technology involves risks and cost and the innovators may have difficulty in capturing the full benefits of their innovations. Furthermore, several establishments who are willing to take that risk face several financial, internal and external obstacles as discussed in Section 8. Thus, there would be less innovation than what is economically optimal unless government plays a role in dealing with some of the market failures. Supporting innovation is also in the interest of government as innovation and technological change contribute to increased productivity and consequently to economic growth.

Government can create an environment for innovation and to ensure the core inputs of innovation such as knowledge and highly skilled people are available (Bell Canada, 2002). In other words, government can act as a facilitator for innovation. Governments can facilitate innovation through their involvement in R&D, human resource development, financial support and export development programs.

Government can encourage R&D through direct financial assistance in the form of grants and credits and the direct provision of research facilities, information on new technologies and technical assistance (West, 2000). According to the Conference Board of Canada (2001), government, universities and the financial system, are the three key pillars that support innovation. Government is, thus, important for the innovative process and in general can choose between three major policy options in supporting private sector R&D: direct and indirect financial support; procurement of leading edge technology; and funding of science and technology infrastructure.

The Canadian government relies heavily on fiscal incentives for supporting private sector R&D with over half of the public support devoted to industrial R&D distributed in this form (Conference Board of Canada, 2001). Some examples include R&D tax credits on scientific research and experimental development (SR&ED) programs and government R&D grants such as Matching Investment Initiative (MII) and Innovation Assistance Programs (IRAP). Private corporations in Canada can earn an investment tax credit of 35% up to the first $2 million of qualified expenditures for SR&ED carried out in Canada, and 20% on any excess amount. Other Canadian corporations, proprietorships, partnerships, and trust, can earn an investment tax credit of 20% of qualified expenditures for SR&ED carried out in Canada (Canada Revenue Agency, 2005).

The government also invests in public research through public organisations and universities. Some 100 federal government research facilities and 46 provincial research facilities are driving public R&D and innovation in Canada (Industry Canada, 2005).

Human resource development is another area critical to innovation for which government support is required. Morck and Yeung (2001) classify human capital into three forms: firm specific; industry-specific; and general human capital, and define firm-specific human capital as knowledge that has value mainly to the firm whereas industry-specific capital is knowledge valuable to any employer in the industry and general human capital is knowledge valuable to any employer anywhere. Firms generally invest in firm-specific human capital and are reluctant to invest in industry-specific or general human capital. Government's spending on industry-specific and general human capital can therefore be important for innovation.

The government also provides financial support for innovation through organisations such as Business Development Bank and Farm Credit Canada. As discussed in Section 8, the government is the third most important source for innovating establishments who seek funding for innovative activities.

Uses and importance of government support to innovation

When establishments were asked to indicate the use and rate the importance of sources of government support with respect to carrying out innovation activities during the past three fiscal years ending in 2003, fiscal incentives such as R&D tax credits and government R&D grants, were reported as the most used and the most important. This result is consistent with results from the 1998 Survey of Advanced Technology in the Food Processing Industry (West, 2000). R&D tax credits (tax credits for scientific research and experimental development programs) is the single most important source of government support with almost 70% of innovating establishments utilising it for their innovative activities over the three-year period. However, only 44% indicated that R&D tax credit is of either medium or high importance to innovation (Table 46). R&D tax credit in Canada is considered one of the most generous programs in the world (Conference Board of Canada, 2001).

Only 33% of innovating establishments utilised export development assistance programs with less than 10% indicating medium or high importance to innovation (Table 46). Government research facility is the second least likely source of government support. Also 36% of innovating establishments reported using government research facilities and only 12% indicated that a government research facility is of medium or high importance to innovation. Thus, although the government continues to commit itself to R&D spending, its actual involvement in providing facilities and undertaking research is not considered very important by innovation establishments in the food processing industry.

Table 46: Use and importance of government support and programs for innovation

SOURCE OF SUPPORT	USE	LOW	MEDIUM	HIGH
	% of innovating establishments			
R&D tax credits (e.g. SR&ED)	68.6	12.1	18.5	25.5
Government R&D grants (e.g. MII, IRAP)	42.6	8.0	6.0	14.6
Government-supported training programs	40.8	11.3	6.5	6.4
Gov. financing support (e.g. Business Development Bank, Farm Credit Canada)	38.5	7.3	5.6	11.8
Government research facilities (e.g. National Research Council)	36.0	10.2	8.5	3.9
Export development assistance (e.g. Export Development Corporation)	32.7	7.4	4.5	4.0

The majority of food processing establishments use R&D tax credits and many of these establishments consider them important regardless of size. Establishments with less than 20 employees are most likely to use government programs, with the exception of R&D tax credits, and consider these programs more important to their innovative activities than medium or larger-sized establishments (Table 47 and 48). On the other hand, establishments with 200 or more employees are most likely to utilise R&D tax credits for their innovative activities and also consider this source to be of medium or high importance to their innovative activities (Table 47 and 48). This is expected as smaller-sized establishments are more likely to have financial difficulties in investing in innovation and therefore depend more on government support and programs. On the other hand, larger-sized establishments have the capacity to generate internal cash flow for innovative activities and can benefit the most from tax credits.

There are also some variations in the use and importance of government support programs by country of control. Although a greater percentage of Canadian-controlled establishments consider most government programs of medium or high importance to their innovative activities, they are less likely to utilize these programs (Table 49 and 50). US-controlled establishments are most likely to utilize all the government support programs for their innovative activities with a greater percentage indicating using the programs. In general, other foreign-controlled establishments are least likely to use government programs and also consider these programs of less importance than Canadian or US-controlled establishments.

Table 47: Use of government support and programs for innovation by establishment size

SOURCE OF SUPPORT	<20	20-49	50-199	200+
	% of innovating establishments			
R&D tax credits (e.g. SR&ED)	59.8	67.0	64.2	85.3
Government R&D grants (e.g. MII, IRAP)	53.9	39.4	42.1	40.4
Government-supported training programs	49.4	41.4	37.9	39.4
Gov. financing support (e.g. Business Development Bank, Farm Credit Canada)	57.7	35.1	37.2	32.7
Government research facilities (e.g. National Research Council)	45.9	35.1	31.0	40.0
Export development assistance (e.g. Export Development Corporation)	40.9	34.3	31.8	26.4

Table 48: Importance of government support and programs for innovation by size

SOURCE OF SUPPORT	<20	20-49	50-199	200+
	% of innovating establishments reporting medium or high importance			
R&D tax credits (e.g. SR&ED)	32.9	44.2	41.0	57.4
Government R&D grants (e.g. MII, IRAP)	30.2	19.8	19.3	17.9
Government-supported training programs	16.5	13.3	8.7	18.0
Gov. financing support (e.g. Business Development Bank, Farm Credit Canada)	19.9	13.8	20.3	15.6
Government research facilities (e.g. National Research Council)	19.8	9.2	11.8	13.0
Export development assistance (e.g. Export Development Corporation)	13.0	8.0	6.5	9.6

Table 49: Use of government support and programs for innovation by country of control

SOURCE OF SUPPORT	CANADA	US	OTHER
	% of innovating establishments		
R&D tax credits (e.g. SR&ED)	68.4	73.1	64.3
Government R&D grants (e.g. MII, IRAP)	42.1	46.9	43.4
Government-supported training programs	40.1	53.3	31.7
Gov. financing support (e.g. Business Development Bank, Farm Credit Canada)	38.1	46.1	32.9
Government research facilities (e.g. National Research Council)	35.6	35.5	42.0
Export development assistance (e.g. Export Development Corporation)	32.2	35.7	34.2

Table 50: Importance of government support and programs for innovation by country of control

SOURCE OF SUPPORT	CANADA	US	OTHER
	% of establishments reporting factor as having medium or high importance		
R&D tax credits (e.g. SR&ED)	45.5	47.3	19.3
Government R&D grants (e.g. MII, IRAP)	21.5	20.1	9.2
Government-supported training programs	12.9	18.5	5.0
Gov. financing support (e.g. Business Development Bank, Farm Credit Canada)	18.6	18.0	–
Government research facilities (e.g. National Research Council)	12.8	10.3	9.2
Export development assistance (e.g. Export Development Corporation)	9.2	6.9	–

Establishments in all the food processing industries use R&D tax credit and consider it as the most important government program for innovation. Poultry processing establishments, however, are most likely to utilize R&D tax credit and have the highest rating of importance for the program. About 84% of innovating establishments in the poultry processing industry reported that they used R&D tax credit during the three-year period ending in 2003 and almost 80% of innovating establishments in the industry also consider R&D tax credits of medium or high importance to their innovative activities (Table 51 and 52). Poultry processing establishments are generally larger in size with 42% reporting 200 or more employees (Table 8). Establishments in the sugar and confectionery; seafood products; and dairy products industries are most likely to

utilize government programs. Establishments in the sugar and confectionery industry also generally rate importance of most of the government programs higher than establishments in other industries. These are also establishments most likely to be engaged in both product and process innovations as indicated earlier in Table 28.

Conclusion

Government support is important for the successful development of innovative products and processes. There is a positive correlation between the use of government support programs and its importance to establishments. Government programs such as R&D tax credits and R&D grants are the most utilised and most important government support programs for innovative activities. Export development programs and government research facilities are the least important sources of government support and least utilised by innovating establishments in the food processing industry.

The use and importance of government programs vary by size, country of control and industry. Establishments with less than 20 employees are most likely to use government programs, with the exception of R&D tax credits, and consider these programs more important to their innovative activities than medium or larger-sized establishments. On the other hand, establishments with 200 or more employees are most likely to utilise R&D tax credits and rank the importance of this program higher than other establishments.

US-controlled establishments are most likely to utilise most of the government support programs, although Canadian-controlled establishments rank the importance of these programs higher than other establishments.

Establishments in all industries use R&D tax credit and consider it as the most important government program for innovation. Poultry processing establishments, however, are most likely to utilize R&D tax credits and has the highest rating of importance for the program. Establishments in the sugar and confectionery; seafood products; and dairy products industries are most likely to utilize government programs, with establishments in the sugar and confectionery industry also generally rating importance of most of the government programs higher than establishments in other industries.

Table 51: Use of government support and programs for innovation by industry

SOURCE OF SUPPORT	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of innovating establishments									
R&D tax credits (e.g. SR&ED)	56.3	81.3	69.2	64.4	73.8	74.8	84.0	63.0	64.9	73.0
Government R&D grants (e.g. MII, IRAP)	45.6	44.8	60.4	36.2	54.4	45.0	17.9	47.8	37.2	41.8
Government financing support (e.g. Business Development Bank, Farm Credit Canada)	50.6	29.0	52.7	38.1	32.9	34.9	6.4	55.7	33.9	45.7
Government research facilities (e.g. National Research Council)	34.1	53.1	48.3	40.0	46.4	38.0	5.4	51.9	27.5	30.1
Export development assistance (e.g. Export Development Corporation)	33.8	29.0	64.8	26.6	35.6	33.5	5.4	37.3	29.2	36.0
Government-supported training programs	37.8	43.1	65.9	37.6	49.0	33.3	16.0	44.6	34.9	55.4

Table 52: Importance of government support and programs for innovation by industry

SOURCE OF SUPPORT	Animal food	Grain and oilseed	Sugar and confec-tionery	Fruit, veg. and spec. food	Dairy products	Meat products	Poultry processing	Seafood products	Bakeries and tortilla	Other food
	% of establishments reporting medium or high importance									
R&D tax credits (e.g. SR&ED)	24.7	38.2	41.7	32.9	59.7	41.9	78.6	33.2	42.0	61.5
Government R&D grants (e.g. MII, IRAP)	16.8	20.3	32.9	17.8	30.2	17.8	17.9	18.4	15.0	30.3
Government-supported training programs	5.0	6.2	25.3	16.6	22.1	4.4	10.6	15.2	10.3	18.5
Government financing support (e.g. Business Development Bank, Farm Credit Canada)	24.7	6.2	24.2	14.0	16.1	12.0	6.4	29.7	16.1	21.5
Government research facilities (e.g. National Research Council)	7.8	36.5	24.2	15.2	21.5	4.5	–	18.7	10.0	5.9
Export development assistance (e.g. Export Development Corporation)	7.4	–	32.9	11.4	14.1	4.4	–	7.6	5.9	5.9

– *Not reported.*

Section 11

Summary and conclusions

The main purpose of this study is to examine the nature and extent of product and process innovations in the Canadian food processing industry by using the *2004 Innovation in the Food Processing Industry Survey* conducted by Statistics Canada for AAFC. The survey targeted all food processing establishments in Canada with annual sales of $1 million or more. The survey was conducted in 2004 and responses to the survey cover activities of food processing establishments for the period 2001 to 2003.

The study found that about 52% of food processing establishments are of small size with less than 50 employees. Size of establishments varies by industry with poultry processing; sugar and confectionery; fruits, vegetables and specialty food having a relatively greater percentage of larger establishments whereas animal food; grain and oilseed; and bakeries and tortilla industries are dominated by smaller establishments.

Most food processing establishments in Canada are owned or controlled by Canadians. According to the survey, about 87% of establishments have majority Canadian ownership. However, a significant share of output is produced by foreign controlled establishments. Country of control varies by size and industry. Larger-sized establishments are more likely to be foreign controlled and foreign-controlled establishments are more likely to be found in grains and oilseed manufacturing, and sugar and confectionery product manufacturing.

Food processing includes the processing of raw agricultural products, semi-prepared food products for use in further processing and food products for end-users. Of the target population, 30% of establishments focused on primary processing of raw agricultural products, 12% on semi-prepared food products for use in further processing and 58% on the processing of food products for end-users.

The competitive environment may have implications for a firm's incentive to innovate. A conducive business environment reduces business risk and encourages establishments to invest in R&D and innovation. Responses from the survey indicate that the top three most important factors impacting the ability of establishments to compete include the increased value of the Canadian dollar, consolidation of food retailers and wholesalers, and availability of competitively

priced raw agricultural products. There are differences between industries in terms of factors impacting competitiveness. A greater percentage of establishments in trade-oriented industries such as seafood products; meat products; sugar and confectionery; and fruit, vegetable and specialty food perceive the increased value of the Canadian dollar as a major impediment to competitiveness than domestically-focused industries. Whereas the value of the Canadian dollar is the major factor for competitiveness by a greater proportion of establishments in almost all industries, availability of competitively-priced raw agricultural product for processing is perceived as the most important factor impeding competitive ability of a greater proportion of establishments in the grain and oilseed industry.

The survey indicates that only 37% of establishments in the food processing industry are engaged in product innovation and 23% in process innovations. One possible reason for the greater proportion of establishments being engaged in product innovation than process innovation is that new products are more easily licensed than new processes. These proportions may, however, underestimate the incidence of innovation as those establishments who are not engaged in innovation may be benefiting from innovation conducted by their parent companies. The survey found that about 44% of establishments have parent companies. In terms of the extent of innovation, the survey responses show that the majority of establishments who were engaged in innovation introduced less than six product or process innovations between 2001 and 2003.

The survey also found that four main methods are used by food processing establishments to develop innovations. Establishments may develop completely new products or processes; significantly adapt, improve or modify existing products or processes available in other markets; copy products or processes available in other markets; or purchase the right to use a process. In product innovation, food processing establishments are more likely to developed completely new products. About 55% of food processing establishments, who introduced product innovation, developed completely new products. In terms of process innovation, establishments are more likely to adapt, improve or modify existing processes with about 68% of establishments adopting this strategy.

The survey responses show that food processing establishments adopt various approaches to protect their innovations. Fast mover strategies, such as trade secrets and lead-time advantage, seem to be more popular among Canadian food processing establishments than legal mechanisms, such as patenting, registration of industrial design and copyright. Patenting, which is sometimes used as an indicator of innovation, is not a very likely approach to be used by food processing establishments in protecting intellectual property. Only 12% of Canadian food processing innovating establishments reported applying for patents.

Investments in R&D are considered an important and necessary input for innovation. However, less than half of food processing establishments are engaged in R&D activities and a greater proportion of such establishments focus more on prototyping and scale-ups than in laboratory-based R&D activities. In addition, the study demonstrates that expenditures on R&D activities in the food processing industry are not significant. However, this is consistent with food processing industry in general which is considered a low-tech industry, where the percentage of revenues allocated to R&D is low.

R&D investments and innovation are expected to be influenced by several factors including the characteristics of establishment and the type of industry. The survey confirms this by showing that larger-sized establishments are more likely to undertake R&D and innovative activities than smaller-sized establishments. Ownership also makes a difference in terms of R&D and innova-

tion. The survey responses show that foreign-controlled establishments are more likely to undertake R&D and innovation than Canadian-controlled establishments. However, Canadian-controlled establishments are more likely to develop completely new products using laboratory-based R&D investigation in establishments, but in terms of process innovation, are more likely to significantly adapt, improve or modify existing equipment, technology and systems through collaboration with packaging and equipment suppliers. On the other hand, foreign-controlled establishments are more likely to copy or significantly adapt, improve or modify existing product or process.

The survey solicited information from establishments on impediments to innovation. Most of the establishments indicated that the difficulty of raising capital for innovation is the greatest impediment to innovation. Other impediments include, in the order of stated importance, long gestation period of innovation, insufficient flexibility in regulations or standards, shortage of skilled workers, lack of marketing capability, lack of retail acceptance or access to distribution channels, corporate or management resistance to innovation, lack of idea champions, and difficulty in negotiating clear intellectual property rights.

The survey also found that the majority of food processing establishments deal with some of the obstacles by collaborating mostly with food ingredient suppliers, equipment suppliers, packaging suppliers, raw agricultural product suppliers and food retailers/wholesalers to develop product and process innovations. Although collaboration with public and private research institutions is rather limited, there are various government programs that target innovation such as R&D tax credits, R&D grants, training programs, financing support programs, public research facilities, and export development assistance. But with the exception of R&D tax credits and to some extent R&D grants, such government programs are not widely used by food processing establishments.

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Innovation in the Food Processing Industry Survey 2004

APPENDIX A

CONFIDENTIAL when completed
Collected under the authority of the Statistics Act,
Revised Statutes of Canada, 1985, Chapter S19

Si vous préférez ce questionnaire en français,
veuillez cocher et retourner ce questionnaire ☐

Small Business and Special Surveys Division
Innovation in the Food Processing Industry Survey

The purpose of the survey

Statistics Canada is conducting this survey on behalf of Agriculture and Agri-Food Canada. The purpose of the survey is to collect statistical information on the nature and extent of creative innovation in the Canadian food processing industry. Results from this survey may be used by businesses or trade associations to study industry performance, government departments and agencies to assist in policy formation and by the academic community for research purposes.

Note of appreciation

Canada owes the success of its statistical system to a long standing co-operation involving Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

Your participation is important

Participation in this survey is voluntary. However, your co-operation is essential to ensure the accuracy of the information collected.

The data you report are confidential

Statistics Canada is prohibited by law from publishing or releasing statistics that could reveal information obtained from this survey relating to an identifiable individual business or person. The data reported on the questionnaire will be treated in strict confidence, used for statistical purposes and released in aggregated form only. The confidentiality provisions of the Statistics Act are not affected by either the Access to Information Act or any other legislation.

Who should complete this questionnaire?

A Plant Manager, Quality Assurance Manager, Research and Development Manager or someone familiar with the products and general activities of this company should complete this questionnaire. If you have any questions regarding this survey or the questionnaire, please contact the Survey Manager, Shelley Harman, toll-free at 1-877-679-2746 or by e-mail at shelley.harman@statcan.ca

Please complete the following information

Name of respondent: |_____|

Title of respondent: |_____|

Telephone number: |__|__|__|-|__|__|__|-|__|__|__|__| ext.: |__|__|__|__|__|

Please correct the pre-printed information, if necessary, using the corresponding boxes:

002	Business name	004	Number and street		
005	City	006	Province	007	Postal code

Statistics Canada Statistique Canada

Canada

GENERAL INFORMATION

1. Which of the following markets is the dominant one for this establishment?

1	5.7%	Atlantic region (Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick)
2	45.9%	Central (Quebec, Ontario)
3	19.7%	Western (Manitoba, Saskatchewan, Alberta, British Columbia)
4	9.6%	National Canadian market
5	13.9%	U.S. market
6		Mexican market
7	5.2%	Other foreign market

2. How many employees (including permanent, seasonal and casual but excluding contract employees) did this establishment employ during its last fiscal year ending in 2003? (Please report your highest level for 2003)

1	21.6%	Less than 20
2	39.6%	20-49
3	33.7%	50-199
4	10.0%	200-499
5	2.9%	500-999
6	1.2%	1,000 or more

3. What were your establishment's annual total sales from food/feed production for the fiscal year ending in 2003?

1	7.1%	$0 to $999,999
2	31.0%	$1,000,000 to $4,999,999
3	17.5%	$5,000,000 to $9,999,999
4	8.5%	$10,000,000 to $14,999,999
5	4.7%	$15,000,000 to $19,999,999
6	4.4%	$20,000,000 to $24,999,999
7	26.8%	$25,000,000+

4. What is the principal food/feed manufacturing activity of your establishment based on proportion of annual total food sales?

1 [30.2%] Primary processing of raw agricultural products (e.g., flour milling, feed milling, animal slaughter, oil-seed processing)

2 [12.0%] Supplying semi-prepared food products for use in further processing (e.g. flour mixes, fruit desert fillings, dairy based ingredients)

3 [57.9%] Manufacturing food products ready for human or animal consumption (e.g. breakfast cereal, frozen dinners, canned foods, sausages, salad dressing, pet food)

4 ☐ Other, please specify _____

5. Please indicate the percent distribution of your establishment's total food sales to the following markets for the fiscal year ending in 2003? (Please complete for all applicable countries and regions)

Market sales as a % of total sales	Canada	U.S.	Mexico	Europe	Asia	Other countries
			Percent			
1 to 24.9	9.7	59.9	4.7	69.4	64.8	83.3
25 to 49	6.8	14.1	0.6	15.7	17.7	9.7
50 to 74	8.6	14.5	0.0	12.0	0.6	0.3
75 to 99	31.9	11.5	0.0	0.1	1.7	0.3
100	43.0		0.0	0.1	0.0	0.0

6. Please indicate the majority ownership of your company.

1 [87.0%] Canadian

2 [8.3%] U.S.

3 [0.0%] Mexican

4 [3.3%] European

5 [ ] Asian

6 [1.5%] Other foreign

7 [ ] Don't know

7. What is the ownership structure of your company?

1	70.0%	Private corporation
2	13.5%	Public corporation
3	8.4%	Sole proprietorship
4	1.3%	Unincorporated partnership
5	5.4%	Cooperative
6	1.5%	Other, please specify _____

COMPETITIVE ENVIRONMENT

8. Please rate how each of the following factors constrained your establishment's ability to compete over the last three fiscal years ending in 2003.

		IMPACT		
FACTOR	Not applicable to this company	Minor	Moderate	Major
a. Lack of access/availability of competitively priced raw agricultural products for processing	0 31.0%	1 32.2%	2 21.6%	3 15.2%
b. Mergers and acquisitions by competitor firms	0 36.53%	1 40.81%	2 16.52%	3 6.14%
c. Consolidation of equipment suppliers and/or packaging suppliers	0 36.69%	1 50.26%	2 10.74%	3 2.31%
d. Consolidation of food retailers and/or wholesalers	0 32.34%	1 31.31%	2 21.06%	3 15.29%
e. Restricted access to distribution channels because of listing fees, exclusivity, etc.	0 36.88%	1 32.19%	2 19.59%	3 11.35%
f. More stringent buyer requirements/standards for food safety and quality	0 17.31%	1 40.40%	2 29.60%	3 12.69%
g. More stringent buyer requirements/practices concerning the environment	0 24.61%	1 51.34%	2 18.48%	3 5.57%
h. Outdated/inflexible food safety regulations (CFIA, USDA, etc.)	0 22.68%	1 41.65%	2 24.09%	3 11.57%
i. Lack of food safety regulations/national standards	0 36.12%	1 48.14%	2 11.12%	3 4.62%
j. Increased value of the Canadian dollar against the U.S. dollar	0 25.40%	1 28.07%	2 17.96%	3 28.57%

9. Please rate the intensity of competition in your industry in the following areas:

FACTOR	INTENSITY OF COMPETITION			
	Not applicable to this company	Low	Medium	High
a. Product price	0 2.3%	1 6.5%	2 27.0%	3 64.1%
b. Product quality	0 2.75%	1 17.43%	2 45.51%	3 34.31%
c. Flexibility in responding to customers needs	0 3.22%	1 23.28%	2 40.26%	3 33.25%
d. Customer service	0 4.16%	1 19.79%	2 39.55%	3 36.50%
e. Customization of products	0 6.81%	1 25.96%	2 44.68%	3 22.55%
f. Offering a wide range of related products	0 8.32%	1 28.09%	2 41.50%	3 22.09%
g. Frequently introducing new/improved products	0 10.29%	1 35.02%	2 35.20%	3 19.48%

10. On what basis does your establishment <u>primarily</u> compete? (Please answer with respect to your principal product lines)

1 34.7% Product price
2 38.9% Product quality
3 10.0% Flexibility in responding to customer needs
4 6.7% Customer service
5 3.1% Customization of consumer products
6 4.8% Offering a wide range of related products
7 1.8% Frequently introducing new/improved products

11. From what source do your establishment's principal products currently face the most competition on the domestic market?

1 78.4% Other Canadian produced products
2 13.0% U.S. imports
3 Mexican imports
4 8.6% Other foreign imports

12. How do the prices for your principal food/feed products compare to those offered by your main competitors? Relative to the prices of our main competitors, generally our prices are:

1	5.5%	Lower by more than 10%
2	9.2%	Lower by less than 10%
3	55.2%	About the same
4	20.1%	Higher by less than 10%
5	10.1%	Higher by more than 10%
6		Don't know

RESEARCH AND DEVELOPMENT

Research is original investigation undertaken on a systematic basis, by means of experiment and/or analysis, to gain knowledge. Development is the application of research findings or other scientific knowledge for the creation of new products and processes. Research and Development (R&D) includes prototyping and scale-up, but excludes the final commercial production of the new products or the commercial use of the new process.

13. Did your establishment conduct/commission any research and development (R&D) during the last three fiscal years ending in 2003? (Please note: R&D also excludes: market research and sales promotion; quality control involving routine analysis and testing of products; research in the social sciences; and routine data collection)

1	45.1%	Yes
2	54.9%	No, please go to question 15

14. Which of the following R&D activities were carried out at your establishment over the last three fiscal years ending in 2003?

a. Laboratory based R&D investigation	Yes	1	68.3%
	No	2	31.7%
b. Prototyping and scale-up	Yes	1	75.3%
	No	2	24.7%

CREATIVE INNOVATION

For the purpose of this survey, product innovations are both goods and services introduced by your firm whose fundamental characteristics or intended uses are new or differ significantly from other products or services produced by your industry in North America. Product innovations may be introduced by developing brand new products, by significantly modifying existing products or by purchasing the right to produce/copying products that are not currently available for sale in North America, but can be found elsewhere in the world.

15. Did your establishment introduce to the market any product innovations during the last three fiscal years ending in 2003? (Please note: changes to your establishment's existing products which only involve minor modifications and/or product differentiation should not be included, i.e., introduction of a common flavour (e.g., chocolate), or ingredients (e.g., nuts, raisins), or aesthetic packaging changes (e.g., size or shape) do not qualify as product innovation)

1	37.8%	Yes
2	63.2%	No, please go to question 22

16. How many product innovations did your establishment introduce during the last three fiscal years ending in 2003?

1	35.5%	1-2
2	34.8%	3-5
3	19.1%	6-10
4	6.9%	11-20
5	3.7%	More than 20

17. Please indicate the method most often used by your establishment to develop product innovations.

1		Purchasing the right to produce and sell the products in North America
2	2.2%	Copying products available elsewhere, but not in North America
3	7.0%	Significantly adapting, improving or modifying existing products
4	54.6%	Developing completely brand new products
5	36.2%	Other, please specify _____

18. On average, over the last fiscal years ending in 2003, what percent of your establishment's annual total sales from food production came from product innovations that were introduced during this time period?

1	33.7%	Less than 5%
2	27.1%	5-9%
3	23.4%	10-19%

4	10.0%	20-49%
5	5.9%	More than 50%
6		Don't know

19. In general, are the margins on your recent innovative products higher than those earned on your establishment's traditional products?

1	64.0%	Yes
2	36.0%	No

The following two questions should be answered in reference only to your most recently introduced product innovation

20. How was your most recently introduced product innovation developed?

1	42.5%	Laboratory based R&D investigation in this establishment
2	22.17%	Laboratory based R&D investigation conducted by your parent company outside this establishment
3	5.17%	Laboratory based R&D investigation contracted out to other firms
4	36.1%	Using prototyping, scale-up and similar engineering services provided by this establishment
5	17.8%	Collaborating with other firms/establishments up and down the agri-food supply chain
6	18.1%	Collaborating with packaging and equipment suppliers
7	2.3%	Licensing/copying products offered outside North America
8	2.3%	Other, please specify _____

21. What was the main objective of your establishment's most recently introduced product innovation in the following three areas?

Product expansion

1	2.84%	Replace product(s) being phased out
2	61.2%	Add new product to your existing lines of products
3	34.8%	Create superior product differentiation and branding
4	1.1%	Not applicable

Market expansion

1	26.9%	Open up new domestic markets
2	11.8%	Open up new foreign markets
3	57.1%	Increase market share
4	4.3%	Not applicable

Product characteristics

1	13.9%	Improve food safety aspects
2	2.7%	Reduce negative environmental impacts (e.g., choice of packaging)
3	57.9%	Meet buyer's standards/requirements
4	25.5%	Not applicable

For the purpose of this survey, process innovations include production techniques, production processes, systems monitoring, and biotechnology processes introduced by your firm that are new to your industry in North America. Process innovations may be introduced by developing brand new equipment, techniques and processes, by significantly modifying existing equipment, techniques and processes or by purchasing the right to use/copying equipment, techniques and processes that are not currently used in your industry in North America.

22. Did your establishment introduce any process innovations during the last three fiscal years ending in 2003? (Please note: purchases of equipment readily available in the market or that are already being used by other firms in your industry in North America and minor modifications to existing equipment and processes that do not significantly enhance performance should not be included)

1	22.5%	Yes
2	77.5%	No, please go to question 27

23. How many process innovations did your establishment introduce during the last three fiscal years ending in 2003?

1	18.8%	1
2	57.9%	2-3
3	13.9%	4-5
4	9.5%	5+

24. Please indicate the method most often used by your establishment to develop process innovations.

1	6.4%	Purchasing the right and being the first to use the equipment/technologies/systems in North America
2	11.3%	Copying equipment/technologies/processes used elsewhere, but not in North America
3	68.3%	Significantly adapting, improving or modifying existing equipment/technologies/systems

4 | 13.2% | Developing completely brand new equipment/technologies/systems

5 | 0.8% | Other, please specify _____

The following two questions should be answered in reference only to your most recently introduced process innovation

25. How was your most recently introduced process innovation developed?

1 | 32.8% | Undertaking laboratory based R&D investigation in this establishment

2 | 6.8% | Using laboratory based R&D investigation conducted by your parent company outside this establishment

3 | 11.1% | Using laboratory based R&D investigation contracted out to other firms

4 | 36.5% | Using prototyping, scale-up and similar engineering services provided by this establishment

5 | 15.5% | Collaborating with other firms/establishments up and down the agri-food supply chain

6 | 41.1% | Collaborating with packaging and equipment suppliers

7 | 3.3% | Licensing/copying equipment/technologies/systems used by your industry outside North America

8 | 0.5% | Licensing/copying equipment/technologies/systems used by other industries but not in your own industry

9 | 0.5% | Other, please specify _____

26. Please rate the impact of your establishment's most recently introduced on each of the following areas.

	IMPACT				
PROCESS INNOVATION	Not applicable	Applicable but no Impact	Minor	Moderate	Major
a. Improving production flexibility	0 13.5%	1 6.8%	2 19.1%	3 31.2%	4 29.3%
b. Improving productivity/reducing cost of production	0 7.2%	1 4.7%	2 13.6%	3 29.2%	4 45.4%
c. Creating ability to produce a new product	0 9.1%	1 10.1%	2 19.8%	3 23.7%	4 37.3%
d. Improving ability to comply with buyer's requirements/standards	0 9.4%	1 13.0%	2 21.2%	3 30.2%	4 26.2%
e. Improving product safety/quality/consistency	0 8.9%	1 7.0%	2 16.6%	3 30.2%	4 37.4%
f. Improving ability to comply with environmental standards/regulations	0 24.8%	1 14.5%	2 26.5%	3 14.7%	4 19.5%

27. What percentage of your establishment's annual total gross expenditures on food processing was spent on creative innovation activities, on average, over the last three fiscal years ending in 2003? (This includes expenses for laboratory based research and development, prototyping, pilot scale-up, and training activities that are linked to the new products and processes)

1	28.9%	None
2	29.0%	Less than 1%
3	31.8%	2-5%
4	6.5%	6-10%
5	3.7%	More than 10%

COMPANY'S RESEARCH AND DEVELOPMENT (R&D)

IMPORTANT: PLEASE READ CAREFULLY!

The following questions are designed to obtain information at the highest reporting level for this business. **If** this establishment is owned by a parent company, please answer the REMAINDER of the questionnaire (to the best of your ability) on behalf of your immediate parent. (Note: it is not necessary to forward the questionnaire to head office for completion. If you do not know the answer to a question, please check 'Don't know').

If this establishment represents the whole company, (i.e., does not have a parent company or other head office) please **continue** answering the questions on behalf of your establishment, as you completed the first half of the questionnaire.

28. Including this particular establishment, please indicate all the countries/regions in which your company has production units and/or laboratory based R&D units.

	Production units	Laboratory based R&D units
a. Canada	1 91.88%	2 37.23%
b. U.S.	1 17.15%	2 12.18%
c. Mexico	1 5.70%	2 1.94%
d. Europe	1 9.26%	2 6.09%
e. Asia	1 7.00%	2 2.61%
f. Other	1 5.74%	2 2.55%
g. Don't know	1 7.32%	2 59.77%

29. How regular does your company carry out laboratory based R&D activities?

1	40.95%	Never, please go to question 31
2	33.65%	On a continuous basis
3	25.40%	Occasionally
4	☐	Don't know

30. Please indicate both the number and percentage of employees in your company that were engaged in laboratory based R&D activities during the last fiscal year ending in 2003?

A. Number

1	12.5%	None
2	80.3%	Less than 20
3	3.9%	20-49
4	3.3%	0-199
5		200 or more
6	☐	Don't know

B. Percentage

1	11.2%	0%
2	68.2%	Less than 3%
3	15.7%	3-10%
4	4.9%	11-20%
5		21% or more
6	☐	Don't know

31. Is your whole company comprised of this one establishment? (Check 'YES' if you have no parent company and if apart from this particular establishment, there are no other establishments/divisions in the company)

1	43.1%	Yes, please go to question 33
2	56.9%	No

32. Does this particular establishment have the authority to make decisions to invest/introduce a product or process innovation as opposed to obtaining approval from head office (i.e., your parent company)?

a. Product innovation	1	43.1%	Yes	2 56.9% No
b. Process innovation	1	45.9%	Yes	2 54.1% No

SUPPORT ACTIVITIES FOR CREATIVE INNOVATION

33. Please indicate the different groups your company has worked with over the last three fiscal years ending in 2003 to develop product and/or process innovations, including innovations not yet introduced on the market.

	Product innovations	Process innovations
a. Raw agricultural product suppliers/organizations	1 22.4%	2 9.4%
b. Food ingredient suppliers	1 40.2%	2 13.65%
c. Equipment suppliers	1 20.2%	2 37.3%
d. Packaging suppliers	1 26.5%	2 22.7%
e. Food retailers/wholesalers	1 22.0%	2 5.2%
f. Foodservice operators	1 14.0%	2 3.3%
g. Competitors	1 4.7%	2 2.7%
h. Consultants	1 16.5%	2 17.5%
i. Commercial laboratories/R&D enterprises	1 14.6%	2 7.0%
j. Universities and colleges	1 12.0%	2 5.7%
k. Federal/provincial government research facilities	1 8.4%	2 4.9%
l. Private research institutions	1 3.8%	2 1.9%
m. None of the above	1 1.70%	2 1.42%
n. Not applicable – Did not develop product or process innovations Please go to question 43	1 ☐	2 ☐

If this company did NOT introduce either product or process innovation(s) in the past 3 fiscal years (i.e., answered 'No' to both questions 15 and 22, please go to question 43, otherwise please continue to question 34.

34. Has your company used any of the following methods to protect its product/process innovations that were introduced over the last three fiscal years ending in 2003?

1	6.4%	Registration of industrial design
2	38.4%	Trademark
3	12.0%	Patent
4	41.5%	Confidentiality agreement/trade secret
5	3.2%	Copyright
6	36.3%	Lead-time advantage on competitors (i.e., first on the market)
7	7.6%	Bundling innovations with other products or services
8	16.8%	Don't know

35. How many patents did your company apply for during the past three years?

	CANADIAN PATENTS	U.S. PATENTS	NUMBER IN OTHER COUNTRIES	NONE	DON'T KNOW
0	90.5%	95.4%			
1	4.2%				
>1	41%				
1 or 2		2.6%			
>2		2.0%			

GOVERNMENT SUPPORT/PROGRAMS

36. Please rate the importance of each of the following sources of support in respect to carrying out your company's innovation activities during the past three fiscal years ending in 2003?

		IMPORTANCE				
SOURCE OF SUPPORT	Did not use	Used but no importance	Low	Medium	High	Don't know
a. R&D **tax credits** (e.g., Scientific Research and Experimental Development Program (SR&ED))	0 31.4%	1 2.6%	2 12.1%	3 18.5%	4 25.5%	5 9.8%
b. Government R&D **grants** (e.g., Matching Investment Initiative (MII), Innovation Assistance Programs (IRAP))	0 57.4%	1 1.4%	2 8.0%	3 6.0%	4 14.6%	5 12.6%
c. Government **financing support** (e.g., Business Development Bank, Farm Credit Canada)	0 61.5%	1 1.9%	2 7.3%	3 5.6%	4 11.8%	5 11.9%
d. Government **research facilities** (e.g., National Research Council)	0 64.0%	1 1.6%	2 10.2%	3 8.5%	4 3.9%	5 11.8%
e. **Export development assistance** (e.g., Export Development Corporation)	0 67.3%	1 3.6%	2 7.4%	3 4.5%	4 4.0%	5 13.2%
f. Government-supported **training program**	0 59.2%	1 3.9%	2 11.3%	3 6.5%	4 6.4%	5 12.7%

OBSTACLES TO INNOVATION

37. Please rate the negative impact of the following factors in limiting your company's ability to introduce innovations.

		IMPACT			
FINANCIAL FACTORS	Not applicable to this company	Low	Moderate	High	Don't know
a. Lack of internally generated cash flow	0 22.7%	1 35.0%	2 20.0%	3 22.2%	4
b. Lack of external equity funding (including venture capital)	0 45.0%	1 29.0%	2 13.3%	3 12.7%	4

	0	1	2	3	4
c. Lack of debt financing	35.9%	38.8%	16.1%	9.1%	
d. Long gestation period of innovation	29.7%	32.9%	26.6%	10.8%	
INTERNAL FACTORS					
e. Lack of marketing capability	20.2%	43.6%	26.0%	10.3%	
f. Corporate/management resistance to innovation	27.4%	56.8%	9.6%	6.2%	
g. Lack of idea champions	22.5%	53.4%	18.2%	5.9%	
OTHER FACTORS					
h. Shortages of skilled workers	19.4%	43.5%	21.4%	15.7%	
i. Insufficient flexibility in regulations or standards	23.2%	39.5%	24.1%	13.2%	
j. Difficulty in negotiating clear intellectual property (IP) rights	46.8%	43.8%	5.7%	3.6%	
k. Lack of retail acceptance or access to distribution channels	28.6%	42.4%	16.1%	13.0%	

38. Did your company attempt to raise capital specifically for innovation during the last three fiscal years ending in 2003?

1 27.6% Yes

2 72.4% No, please go to question 43

39. Was your company successful in reaching its target in funds?

1 68.2% Yes

2 31.8% No

40. What was the <u>main</u> source of the capital raised?

1 17.8% Canadian based venture capital

2 1.5% American based venture capital

3 2.3% Other foreign based venture capital

4 2.1% Angel investors/family/friends

5 0.9% Initial public offering (IPO)

6	0.0%	Post IPO stock issues
7	2.2%	Joint venture
8	42.1%	Banks, cooperatives and credit unions
9	16.0%	Government sources
10		Don't know
11	15.1%	Other, please specify _____

41. Was your company limited or refused any request(s) for funds from any source when raising capital for innovation?

1	34.9%	Yes
2	65.1%	No, please go to question 43

42. What reason(s) did the lender(s) give in limiting or refusing your request for capital?

1	23.0%	Capital not available due to market conditions
2	10.8%	Further development or proof of concept required
3	22.7%	Lender does not fund development projects
4	0.0%	Lack of intellectual property
5	0.0%	Lack of long term strategic planning
6	0.0%	Lack of marketing analysis
7	39.3%	Failed to meet lending criteria
8	13.5%	Lack of evidence to support projections
9		Other

RESTRUCTURING BUSINESS RELATIONSHIPS

Restructuring business relationships occurs when a company makes changes in the way it does business with other firms/establishments either to provide customers with a product that more closely matches the characteristics that they desire or to generate significant cost savings.

43. Did your company restructure or alter any business relationship(s) that has affected this particular establishment during the past three fiscal years ending in 2003?

1	19.5%	Yes
2	80.5%	No, please go to end of survey

44. Please identify how your company has <u>altered</u> its business relationship(s) with respect to this establishment during the past three fiscal years ending in 2003.

1	51.9%	Entered into strategic alliances, joint ventures or value chains
2	24.8%	Engaged in vertical integration (i.e., merging and/or acquiring other parts of your supply chain)
3		Disinvested in upstream/downstream industries
4	25.9%	Entered into contracts specifying production requirements for raw agricultural inputs (i.e., contracts specifying animal feed/care, crop production method, variety grown, chemical input, etc.)
5	24.9%	Expanded outsourcing of support functions (logistics, information technology, human resources, customer service, finance/accounting)
6	19.8%	Other, please specify _____

45. What was your company's main objective in restructuring its business relationship(s) with respect to this establishment during the past three fiscal years ending in 2003?

1	26.2%	To focus on the provision of low price "consumer-value" goods
2	31.9%	To focus on new markets or channels
3	18.1%	To improve product differentiation and branding
4	6.8%	To improve food safety
5		To develop environmentally-friendly products and processes
6	17.0%	Other, please specify _____

46. Please rate the impact of restructuring the company's business relationship(s) with respect to this establishment on the following business areas.

	IMPACT			
BUSINESS AREA	Not applicable to this company	Minor	Moderate	Major
a. Improving interactions with customers	0 7.6%	1 24.3%	2 41.1%	3 27.0%
b. Improving ability to source raw agricultural products and food ingredients	0 17.9%	1 34.2%	2 26.9%	3 21.0%
c. Improving interactions with non-agricultural product suppliers (i.e., equipment, packaging and processed food product suppliers)	0 18.3%	1 41.6%	2 28.1%	3 12.0%
d. Increasing transportation and logistical efficiency	0 13.2%	1 30.5%	2 34.8%	3 21.5%

e. Improving capital/capacity utilization	0 14.0%	1 24.5%	2 32.1%	3 29.5%
f. Improving raw materials input usage	0 12.0%	1 33.0%	2 34.7%	3 20.3%
g. Enhancing track and trace capabilities	0 23.2%	1 40.3%	2 24.7%	3 11.9%
h. Improving access to state-of-the-art technologies	0 24.6%	1 39.6%	2 21.9%	3 14.0%
i. Improving inventory control	0 16.1%	1 33.8%	2 27.5%	3 22.5%
j. Improving market share	0 7.6%	1 21.1%	2 36.4%	3 34.9%
k. Improving ability to attract skilled workers	0 21.9%	1 47.9%	2 19.8%	3 10.5%
l. Maintaining/improving exports	0 37.3%	1 24.5%	2 19.8%	3 18.4%