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Innovation in the Canadian Manufacturing Sector: Results from the Survey of Innovation 2005

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Symbols

The following standard symbols are used in Statistics Canada publications:

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

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Acknowledgements

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Preface

Innovation, including the adoption and dissemination of innovative technologies and practices, is vital to economic growth and development. It is through innovation that new products are introduced to the market, new production processes are developed and introduced, and organisational changes are made. Through the adoption of newer and more advanced technologies and practices, industries are able to increase their production capabilities, improve their productivity, and expand their lines of goods and services.

In 1993, the first survey of innovation and adoption of advanced technologies in the Canadian manufacturing sector was carried out by Statistics Canada. It was followed by a survey of innovation in the communications, financial services and technical business services industries, conducted by the Science, Innovation and Electronic Information Division (SIEID) in 1996. The 1999 Survey of Innovation surveyed manufacturing industries and, for the first time, selected natural resource industries. The Survey of Innovation, 2003 focused on innovation activities in selected service industries, including all of the industries belonging to the services component of the information and communication technology (ICT) sector, as well as selected professional services, selected transportation services and selected natural resource support service industries.

The division has carried out numerous other surveys that also contribute to an understanding of the use and planned use of advanced technologies and practices.

SIEID carried out biotechnology surveys in 1996, 1997, 1999, 2001, 2003 and 2005 which examined both the development of new biotechnology products and processes, and the use and planned use of biotechnologies. The Bioproducts Development Survey was also conducted in 2003 and 2006. The Functional Foods and Nutraceuticals Survey was carried out in 2003 and 2005.

In addition to the Surveys of Advanced Manufacturing Technologies that were carried out in 1987, 1989, 1993 and 1998, surveys on the use and planned use of information and communication technologies have been carried out annually since 1999 through the Survey of Electronic Commerce and Technology. Data collection for the Survey of Advanced Technology 2007, surveying the manufacturing and logging industries, began in the fall of 2007 with preliminary results released on June 26, 2008.

This working paper is expected to serve as an overview of the results of the 2005 Survey of Innovation for manufacturing. It is part of a series of analytical products, including Innovation Analysis Bulletin articles (Statistics Canada catalogue no. 88-003-XWE), that will present results from the survey.

Highlights

- **Percentage of innovative manufacturing plants:** Results from the Survey of Innovation 2005 show that two thirds (65.0%) of Canadian manufacturing plants were innovative during the three years, 2002 to 2004; that is, they introduced a new or significantly improved product to the marketplace or implemented a new or significantly improved production process, distribution method, or support activity for their goods or services during this period.

- **Novelty of innovation:** Among all innovative manufacturing plants in Canada, one in ten (12.2%) had at least one world-first innovation (product or process) during the three years, 2002 to 2004.

- **Sources of information contributing to innovation:** The three internal sources of information for new innovation projects that contributed to the completion of existing innovation projects or provided information for the commercialization of innovation most often identified by innovative manufacturing plants as important sources of information were management staff (96.1%), production staff (93.8%) and sales and marketing staff (89.4%).

- Clients or customers (91.2%), and suppliers of equipment, materials, components or software (89.7%) were the two external sources of information most often identified as important to innovative manufacturing plants.

- **Activities linked to innovation:** Internal research and development linked to new or significantly improved products and acquisition of advanced machinery, equipment, computer hardware or software to produce new or significantly improved products or processes were the innovation activities carried out by the highest percentage of innovative manufacturing plants with four out of five (81.8% and 79.4% respectively) having carried out these activities.

- **Development of innovation:** During the three years, 2002 to 2004, most innovations were developed within the plant or the plant's firm. Three out of four (73.4%) product innovative manufacturing plants and two out of three (64.2%) process innovative manufacturing plants developed innovations within their own plant or firm.

- **Cooperation with innovation partners:** During the three years, 2002 to 2004, one in five (21.5%) innovative manufacturing plants co-operated with other plants within their firm, other firms or institutions on innovation activities. A high percentage (84.8%) of plants in co-operative arrangements collaborated with other plants within their firm, other firms or institutions in their own province or territory.

- **Impacts of innovation:** Meeting the requirements of existing clients was the market impact of innovation most often identified by innovative manufacturing plants (57.7%) as having high importance during the three years, 2002 to 2004. Increasing the plant's productivity was indicated by half of innovative manufacturing plants (54.0%) as having high importance.

- **Sources of revenue:** In 2004, the most important client or customer (that was not part of the plant's firm) for innovative manufacturing plants accounted for, on average, 27.5% of their total revenue.

- **Obstacles to innovation:** The obstacles most often identified as having high importance for slowing down or causing problems for innovation activities or innovation projects by innovative manufacturing plants during the development of innovation were lack of funds within the plant or firm for innovation (28.7%) and the inability to devote staff to innovation projects on an on-going basis because of production requirements (24.2%).

- The obstacle to the commercialization of innovation most often identified as having high importance was a market dominated by established firms (16.5%).
- **Use of government programs:** Six out of ten (61%) innovative manufacturing plants used at least one government sponsored program during the three years, 2002 to 2004. The program used by the highest percentage of manufacturing innovators was research and development (R&D) tax credits (51.6%).
- **Intellectual property protection:** During the three years, 2002 to 2004, 86.0% of innovative manufacturing plants used some method to protect their intellectual property. Confidentiality agreements (54.0%) were the formal method of intellectual property protection used by the greatest percentage of innovative manufacturing plants.
- **Licensing agreements:** During the three years, 2002 to 2004, one in six (16.9%) innovative manufacturing plants acquired licenses from other firms or organizations.
- **Suppliers to innovative manufacturing plants:** Innovative manufacturing plants were more likely to have suppliers of raw materials and components form the United States (78.5%) than from the rest of Canada (67.2%) in 2004.
- Among the three out of every four (74.2%) innovative manufacturing plants that purchased new machinery or equipment in 2004, three quarters (74.6%) had suppliers in their own province or territory, one third (36.8%) had suppliers in the rest of Canada and more than half (56.1%) made purchases from the United States.
- Approximately one in seven (14.9%) innovative manufacturing plants contracted out for R&D services in 2004. Innovative manufacturing plants were no more likely to contract out for R&D services to the rest of Canada (20.1%) than to the United States (19.4%) and were just as likely to contract out for R&D services to European countries (7.2%) as they were to Asia Pacific countries (4.4%) in 2004.

Innovation in the Canadian Manufacturing Sector: Results from the Survey of Innovation 2005

by Mark Uhrbach

1 Introduction

Innovation may be thought of as the transformation of knowledge into economic activity, a continuum running from invention to commercialization (bringing a new product to the market or a new process to the workplace). From this perspective, innovation performs a vital role contributing to economic growth and development. Through innovation, new products are introduced into the marketplace, new production processes are developed and organizational changes are made.

2 Survey of Innovation 2005 methodology

The data used in this paper are from the Survey of Innovation 2005. The survey was conducted following the Oslo Manual's[1] guidelines for the collection and interpretation of innovation data. At the time of questionnaire development the second edition of the Oslo Manual was the most current.

The target population was manufacturing and logging establishments operating in Canada.

> "The establishment is the level at which the accounting data required to measure production is available (principal inputs, revenues, salaries and wages). The establishment, as a statistical unit, is defined as the most homogeneous unit of production for which the business maintains accounting records from which it is possible to assemble all the data elements required to compile the full structure of the gross value of production (total sales or shipments, and inventories), the cost of materials and services, and labour and capital used in production."[2]

This paper will analyse the manufacturing sector at the national level.

The sample unit for the Survey of Innovation 2005 was the 'statistical establishment,' for which the questionnaire substituted 'plant.' The more familiar latter term is used in presenting results in this paper. Plants were asked whether or not they belonged to a larger "firm", which corresponds to the statistical concept of the enterprise. The term, "firm", was used to refer to all plants and operations in Canada or in other countries that comprise the overall company. The target respondent for the questionnaire was the chief executive officer (CEO) or senior plant manager.

The sample included 8,902 manufacturing plants out of a total population of 17,726.[3] In order to reduce the response burden on small businesses, only plants with at least 20 employees and at least $250,000 in revenues were considered during the sample selection.

The Survey of Innovation 2005 achieved a response rate of 71.4% for manufacturing. Response rate is calculated as the total number of completed questionnaires as a percentage of the number of total active, in-scope sample units.

1. Organization for Economic Cooperation and Development/Eurostat (2005), Guidelines for Collecting and Interpreting Innovation Data, 2nd Edition. Paris; OECD. Available at: *http://www.oecd.org/sti/oslomanual*.
2. Definitions of Standard Statistical Units. Available at: *http://www.statcan.ca /english/concepts/stat-unit-def.htm*.
3. Details on the Survey of Innovation 2005 are available on the Statistics Canada web site at: *http://www.statcan.ca/english/sdds/4218.htm*.

In the charts presented in this paper, each estimate is graphically illustrated as a bar. The confidence interval,[4] a double ended line extending through the end of each bar, shows that the estimate lies within the indicated range of values 95% of the time. Individual estimates with confidence intervals that overlap are not statistically significantly different from each other; those with confidence intervals that do not overlap are statistically significantly different from each other.

3 What is innovation?

The Oslo Manual outlines proposed guidelines for collecting and interpreting innovation data and allows the production of internationally comparable, meaningful indicators of innovation. The second edition of this manual identifies two types of technological innovation — product innovation and process innovation.

> *An innovative firm or plant is one that has introduced a new or significantly improved product onto the market or introduced a new or significantly improved process into the production process during the previous three years.*

In the case of product innovation, the product must, at a minimum, be new to the plant and it must have been introduced to the market as opposed to simply being ready for market introduction. The term “product” includes both goods and services. Complex products may be innovative as a result of changes to one of the components or subsystems. Changes to a plant’s existing products that are purely aesthetic, or that involve only minor modifications, are not considered to be innovations.

A process innovation must have been actually used within the plant’s production process. New or significantly improved processes are those that are new to the plant. Three types of process innovations are considered: methods of manufacturing or producing goods or services; improved logistics, delivery or distribution methods for inputs, goods or services; and supporting activities for processes.

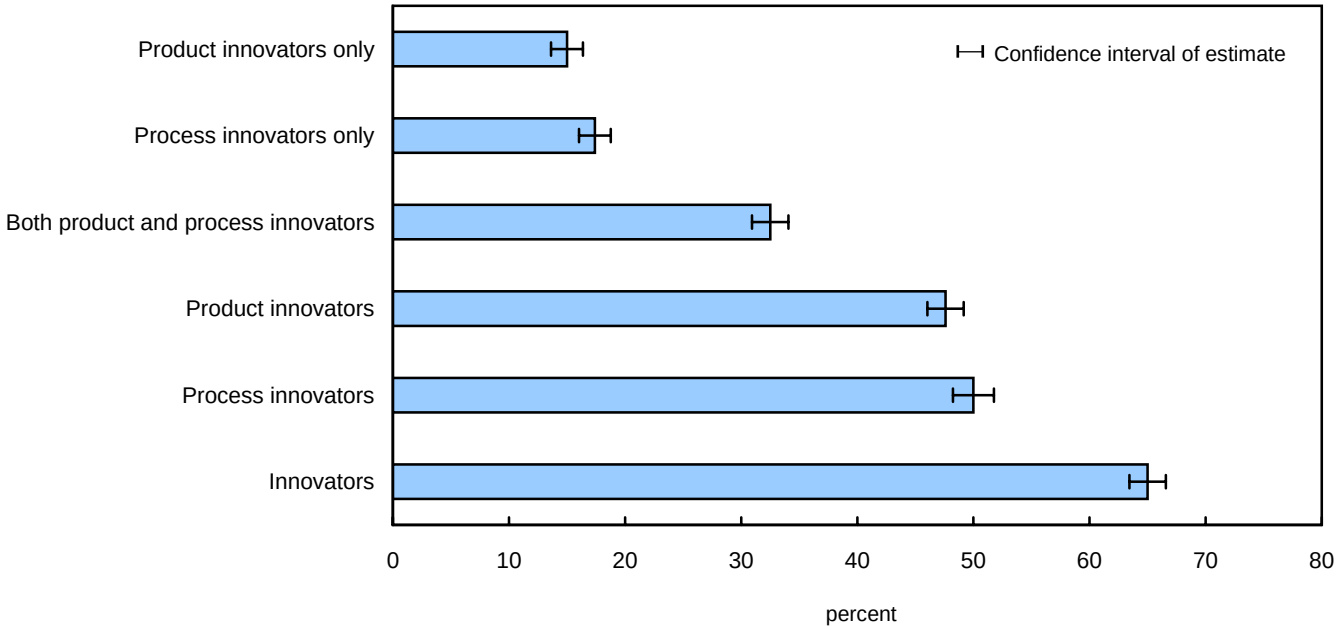
4 Product and process innovation

Results from the Survey of Innovation 2005 show that two thirds (65.0%) of Canadian manufacturing plants were innovative (Chart 1); that is, the plant offered a new or significantly improved product to its clients and/or introduced a new or significantly improved process during the three years 2002 to 2004.

Manufacturing plants were no more likely to be product innovators than they were to be process innovators. One-half (47.6%) of Canadian manufacturing plants introduced product innovations and one half introduced process innovations (50.0%). One-third (32.5%) of Canadian manufacturing plants were both product and process innovators. Manufacturing plants were no more likely to be product innovators only (15.0%) than they were to be process innovators only (17.4%).

4. As the sample drawn for the Survey of Innovation 2005 was only one of many possible samples that could have been drawn using probability sampling methods, a sampling error can be attributed to each estimate. Standard errors combined with imputation rates have been used to provide a guide as to the reliability of percent estimates. The System for Estimating Variance due to Non-response and Imputation program (SEVANI) was used to complete these calculations. For the Survey of Innovation 2005, a 95% confidence interval was used in the probability sample scheme.

Chart 1
Percentage of innovative manufacturing plants during the three years, 2002 to 2004

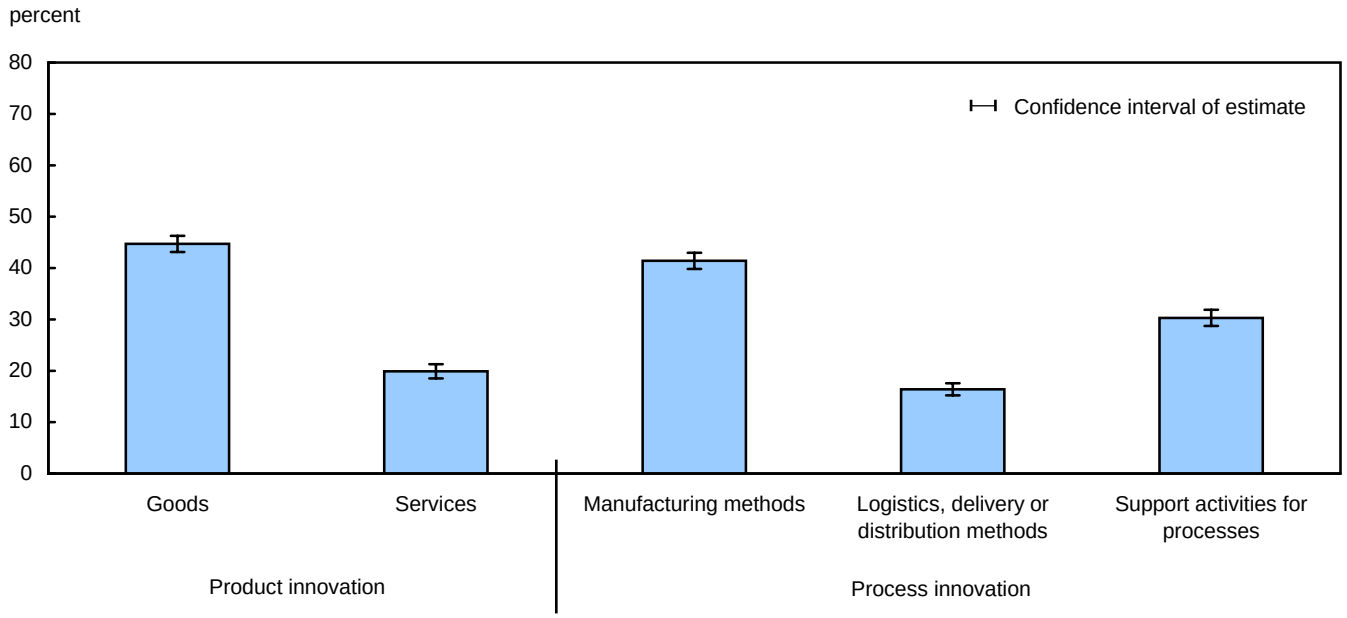


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0062.

Manufacturing plants were more likely to have developed a new or significantly improved good (44.7%) than a service (19.9%) as a product innovation (Chart 2). On average, product innovative manufacturing plants took 13.7 months to develop their product innovations (goods or services).

Among the three types of process innovations, manufacturing plants were most likely to have introduced new or significantly improved methods of manufacturing or producing goods or services (41.4%) followed by new or significantly improved supporting activities for processes, such as maintenance systems or operations for purchasing, accounting, or computing (30.3%) and finally, new or significantly improved logistics, delivery or distribution methods for inputs, goods or services (16.4%).

Chart 2
Percentage of innovative manufacturing plants engaging in different types of innovation during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0062.

Half (51.9%) of manufacturing plants (72.6% of innovative and 13.4% of non-innovative manufacturing plants) had activities to develop product or process innovations that were still ongoing at the end of 2004.

During the period 2002 to 2004, one-quarter (27.5%) of manufacturing plants (38.8% of innovative and 6.5% of non-innovative manufacturing plants) had activities to develop product or process innovations that were abandoned.

5 Novelty of innovation

Respondents were asked to indicate whether any of their new or significantly improved products introduced during the years 2002 to 2004 were considered a first in their province or territory, a first in Canada, a first in North America, or a first in the world.[5] They were asked the same of their new or significantly improved processes. By definition, if an innovation was a world-first, it was also considered a first in the other three categories. One in ten (12.2%) innovative manufacturing plants indicated they had either at least one world-first product or process innovation. Further, one in four (24.2%) innovative manufacturing plants had at least one innovation (product or process) that was a first in North America, 37.5% of plants had a first in Canada and one out of two (49.5%) plants had at least one innovation that was the first of its kind in their province or territory.

Among plants that had a product innovation, 14.6% had at least one world-first product innovation. However, only 4.8% of plants that had a process innovation had at least one world-first process innovation.

6 Sources of information contributing to innovation

The sources of information needed for suggesting or contributing to the development of innovations, new or significantly improved products or processes, may be located within or outside the plant. The outside sources may arise from working relationships of the plant with its clients, suppliers, consultants, various laboratories or even

5. Respondents could indicate a “yes”, “no” or “do not know” response. The results presented reflect the percentage of plants that indicated “yes”.

competitors. Finally, the information may be generally available to the public through means such as scientific journals or the Internet.

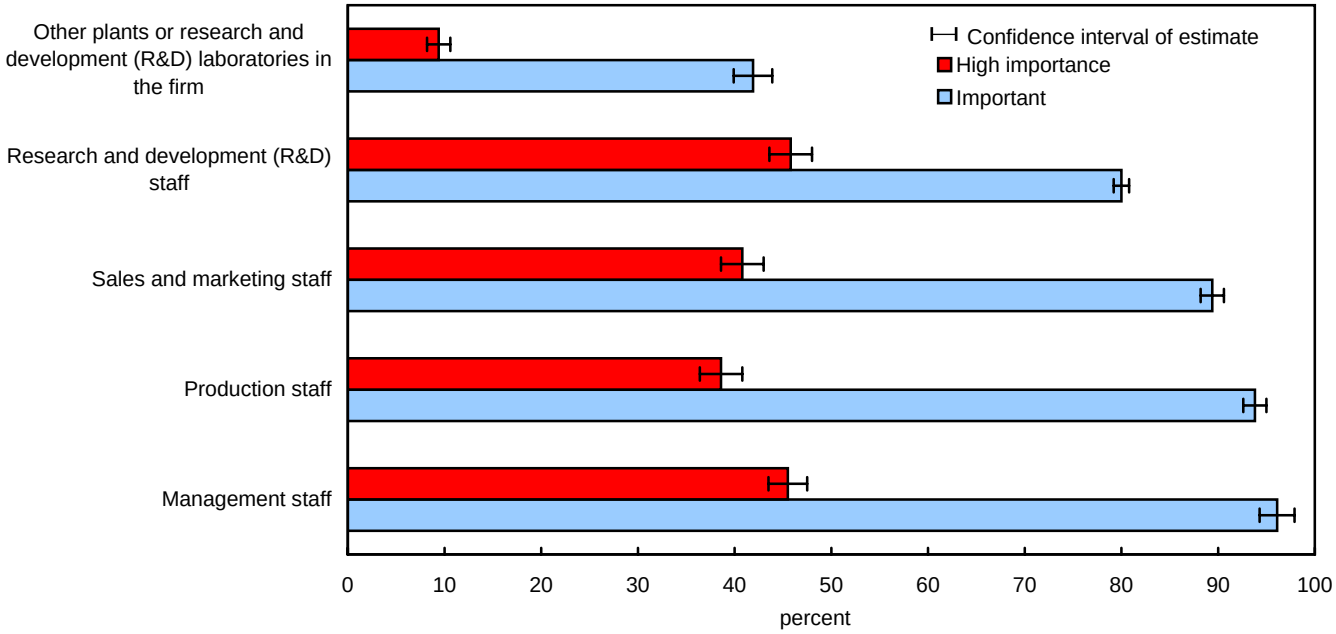
Innovative manufacturing plants were asked to identify, by rating the degree of importance[6] of both internal and external sources of information that provided information for new innovation projects, contributed to the completion of existing innovation projects, or provided information for the commercialization of innovation.

Internal Sources of Information

The three internal sources most often identified by innovative manufacturing plants as important sources of information for innovation were management staff (96.1%), production staff (93.8%) and sales and marketing staff (89.4%) (Chart 3).

Research and development staff (45.8%) and management staff (45.5%) were the most frequently indicated internal sources of information rated with high importance. Following these two sources, sales and marketing staff and production staff were equally likely to rate a high importance indicated by 40.8% and 38.6% of innovative manufacturing plants respectively.

Chart 3
Percentage of innovative manufacturing plants identifying internal sources of information that contributed to innovation during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0089.

External sources of information

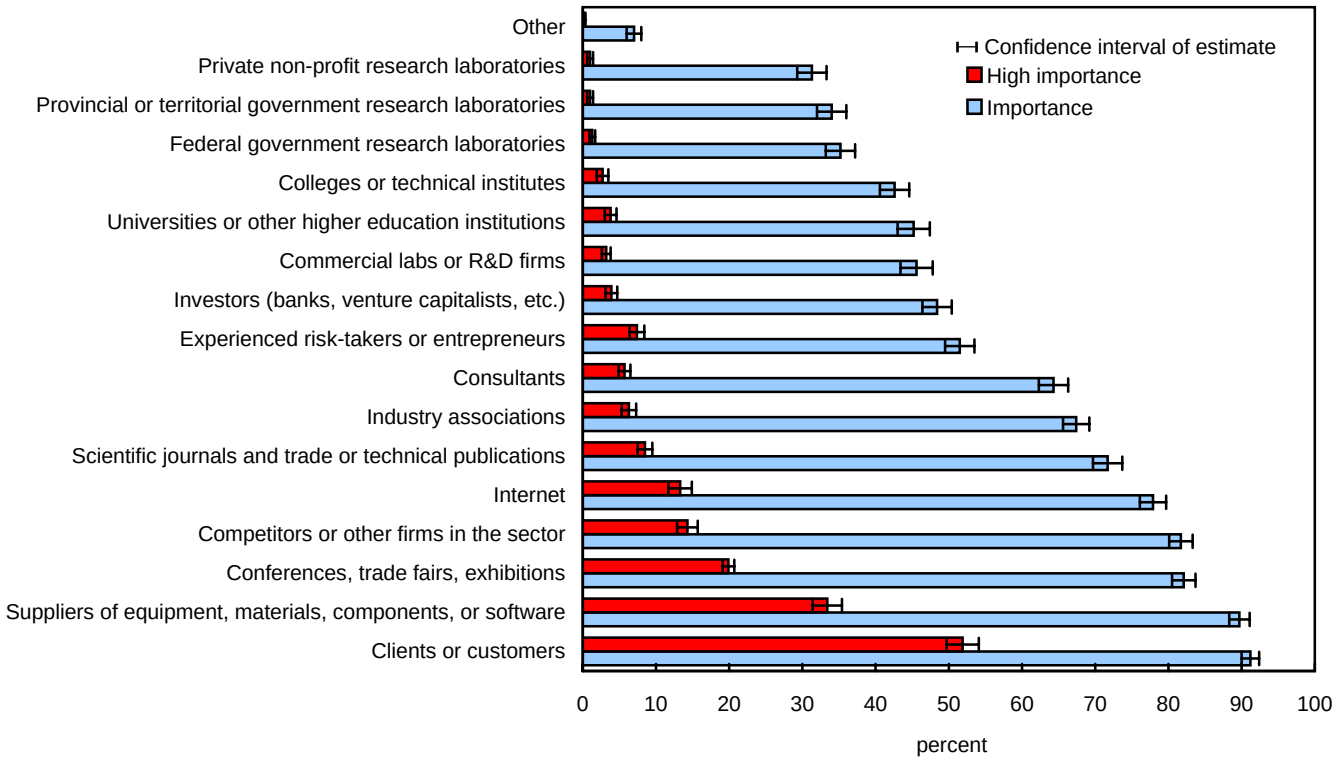
Clients or customers (91.2%), and suppliers of equipment, materials, components or software (89.7%) were the two external sources of information most often identified as important to innovative manufacturing plants (Chart 4). These external sources of information also tend to be those that the plant is likely to interact with most often during their normal course of daily operations. Plants are equally likely to identify conferences, trade fairs and exhibitions (82.1%) as an important external source of information for innovations as they are to identify competitors or other firms in the plant's sector (81.7%).

6. Respondents were asked to indicate the importance as either high, medium or low or if the source was not relevant. The descriptive text portion of this document and the accompanying charts will make a distinction between those items deemed of high importance and those that were deemed "important" (high, medium or low importance).

Clients (51.9%) were the external source of information most often indicated as having a high importance for innovation followed by suppliers, indicated by one third of plants (33.4%) and finally by conferences, trade fairs and exhibitions indicated by one in five plants (19.9%).

Chart 4

Percentage of innovative manufacturing plants identifying external sources of information that contributed to innovation during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0089.

7 Activities linked to innovation

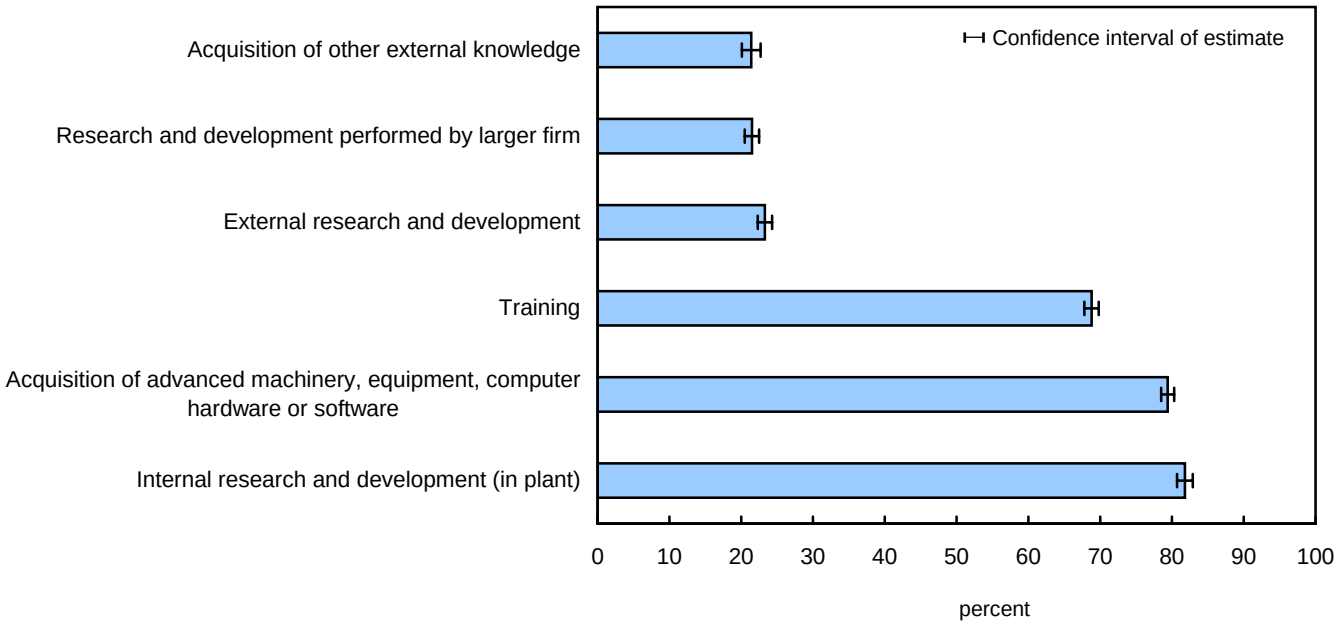
The innovation process can involve a broad range of activities. These have been broken down into three major categories: general innovation activities; market introduction activities; and post-commercialization activities. General innovation activities may include: engaging in R&D inside the plant or firm; purchasing R&D from outside the plant and firm, acquisition of equipment, machinery and software; purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other firms or organizations; and training. Activities related to market introduction of innovative products may include: market research; launch advertising; market plan; production positioning or profiling; profitability analysis; project feasibility study; and testing to measure consumer acceptance. Post-commercialization activities are important to ensure the success of a newly launched innovation. These include: post-introduction advertising campaigns; distribution agreements; international marketing partnerships; and after sales consumer feedback.

Innovative manufacturing plants indicated whether they participated in the previously mentioned general activities linked to innovation during the three years 2002 to 2004. Internal research and development linked to new or significantly improved products, and acquisition of advanced machinery, equipment, computer hardware or software to produce new or significantly improved products or processes were the activities carried out by the highest percentage of innovative manufacturing plants (Chart 5). Four out of five innovative manufacturing plants (81.8% and 79.4% respectively) carried out these activities. These were followed closely by training, indicated by

one in seven (68.8%) innovative manufacturing plants. Finally, one in five innovative manufacturing plants indicated they engaged in external R&D, R&D performed by the larger firm, and acquisition of other external knowledge.

On average, innovative manufacturing plants devoted one tenth (10.1%) of the plant's total expenditures toward innovation activities. More than eight out of ten (85.4%) innovative manufacturing plants devoted between one and twenty five percent of the plant's total expenditures to innovation activities during the period 2002 to 2004.

Chart 5
Percentage of plants engaged in innovation activities during the three years, 2002 to 2004

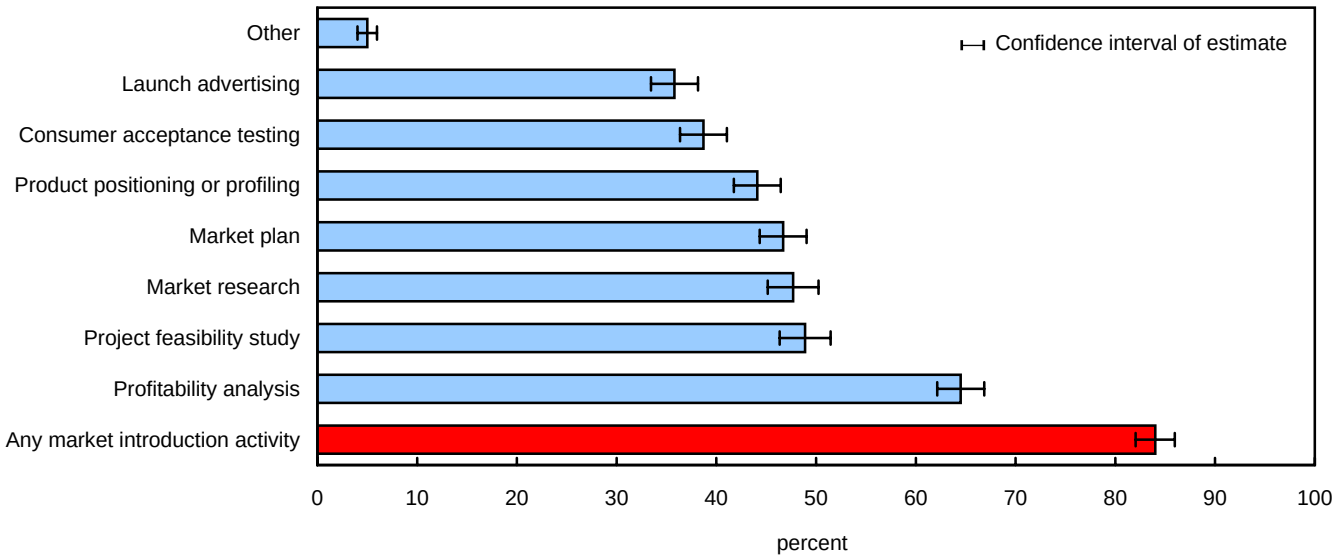


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0087.

Market introduction activities

During the three years, 2002 to 2004, four out of five (84.0%) innovative manufacturing plants participated in at least one activity for the market introduction of new or significantly improved products (goods or services) (Chart 6). The market introduction activity most likely to be undertaken by innovative manufacturing plants was profitability analysis, conducted by two thirds (64.5%) of innovative manufacturing plants.

Chart 6
Percentage of innovative manufacturing plants engaging in activities for the market introduction of new or significantly improved products during the three years, 2002 to 2004

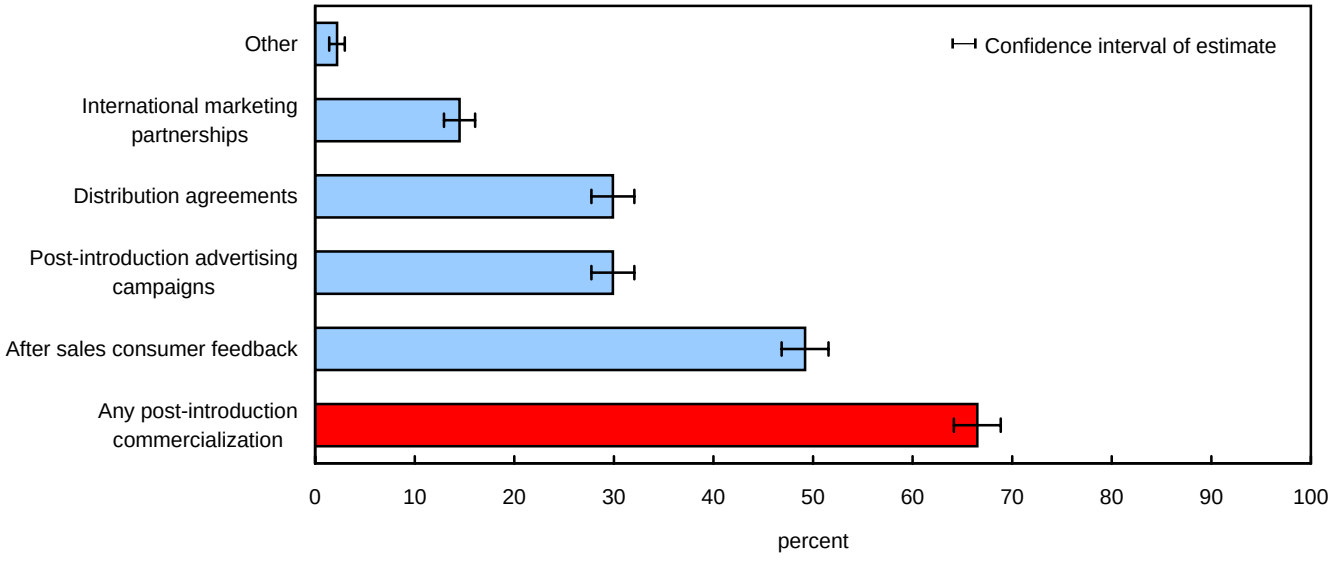


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0087.

Post-introduction commercialization activities

Two-thirds (66.5%) of innovative manufacturing plants undertook at least one activity to enhance the commercial success of their new or significantly improved products (goods or services) during the three years, 2002 to 2004 (Chart 7). After-sales consumer feedback was the most common post-introduction commercialization activity, undertaken by half (49.2%) of innovative manufacturing plants.

Chart 7
Percentage of innovative manufacturing plants engaging in post-commercialization activities during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0087.

8 Development of innovation

Innovations can be developed in one of three principal ways: mainly from within the plant (including the larger firm the plant is part of); in co-operation with other firms or organizations; or mainly by other firms or organizations.

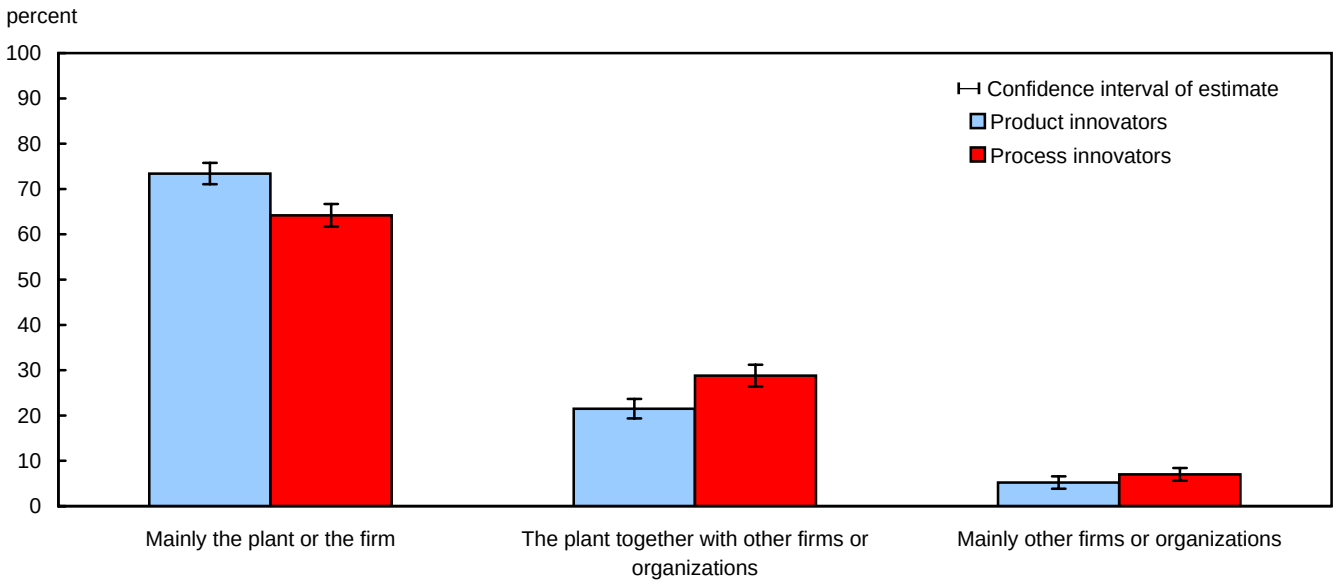
Respondents were asked to indicate who developed both their product and process innovations during the three years 2002 to 2004. The majority of innovative manufacturing plants developed their innovations mainly within their own plant or firm with three quarters (73.4%) of product innovators and 64.2% of process innovators having developed innovations this way.

Among the remaining product innovative manufacturing plants, two out of ten (21.5%) developed product innovations in cooperation with other firms or organizations and one in twenty (5.2%) relied mainly on other firms or organizations to develop their product innovations.

Among the remaining process innovators, three out of ten (28.8%) cooperated with other firms or organizations to innovate and seven percent (7.0%) had process innovations developed mainly by other firms or organizations.

Process innovators are more likely than product innovators to develop innovations in cooperation with other firms or organizations whereas product innovators are more likely than process innovators to develop innovations mainly within their own plant or firm. There is an equal likelihood that a product or process innovator will have innovations developed by another firm or organization.

Chart 8
Percentage of innovative manufacturing plants indicating who developed their innovations introduced during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0073 and 358-0082.

9 Co-operation with innovation partners

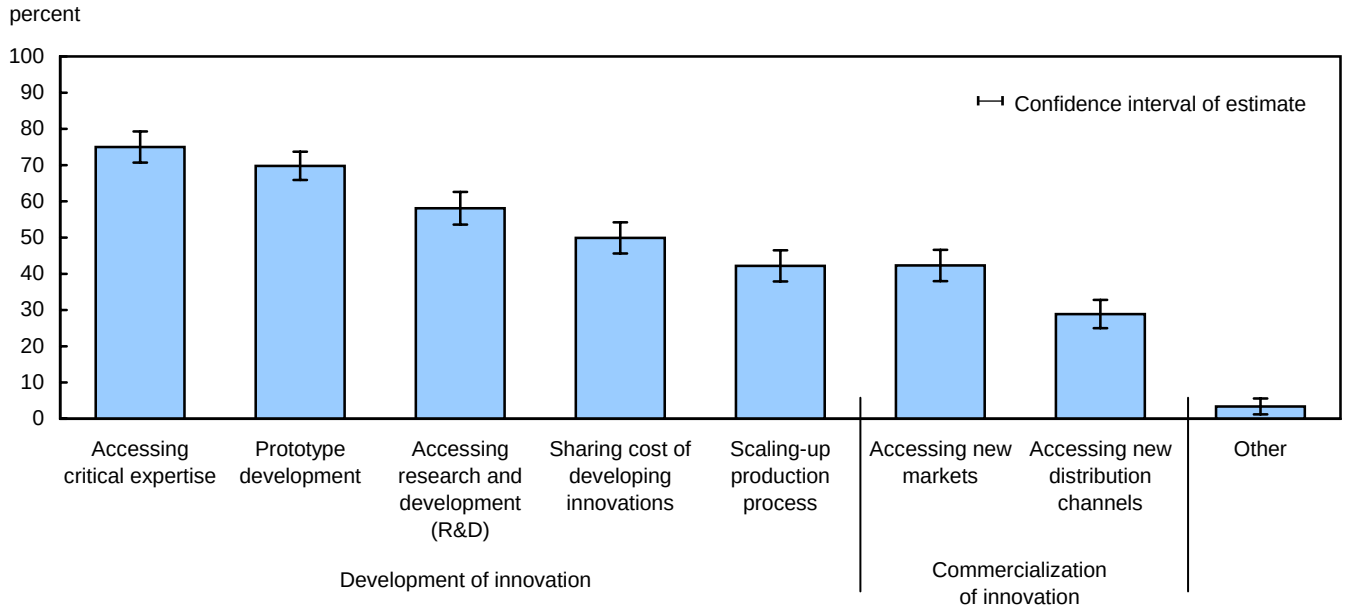
As mentioned above, plants may choose to engage in cooperative or collaborative arrangements to innovate. These arrangements involve the active participation in joint projects between the plant and other firms or organizations in order to develop new or significantly improved products (goods or services) or processes. Pure contracting out of work, where there is no active collaboration, is not regarded as co-operation. The reasons for participating in these arrangements may be many, ranging from the need to access critical expertise to the desire to share the financial cost of a project that may be beneficial to both collaborators.

During the three years, 2002 to 2004, one in five (21.5%) innovative manufacturing plants co-operated on innovation activities with other plants within their firm or other firms or institutions.

Two reasons indicated by the highest percentage of innovative manufacturing plants in cooperative arrangements as important reasons in determining the involvement of their plant in cooperative arrangements were related to development of innovations: accessing critical expertise (75.0%) and prototype development (69.8%) (Chart 9).

Accessing new markets (42.3%) was the reason related to commercialization indicated by the highest percentage of innovative manufacturing plants in co-operative arrangements followed by accessing new distribution channels (28.9%).

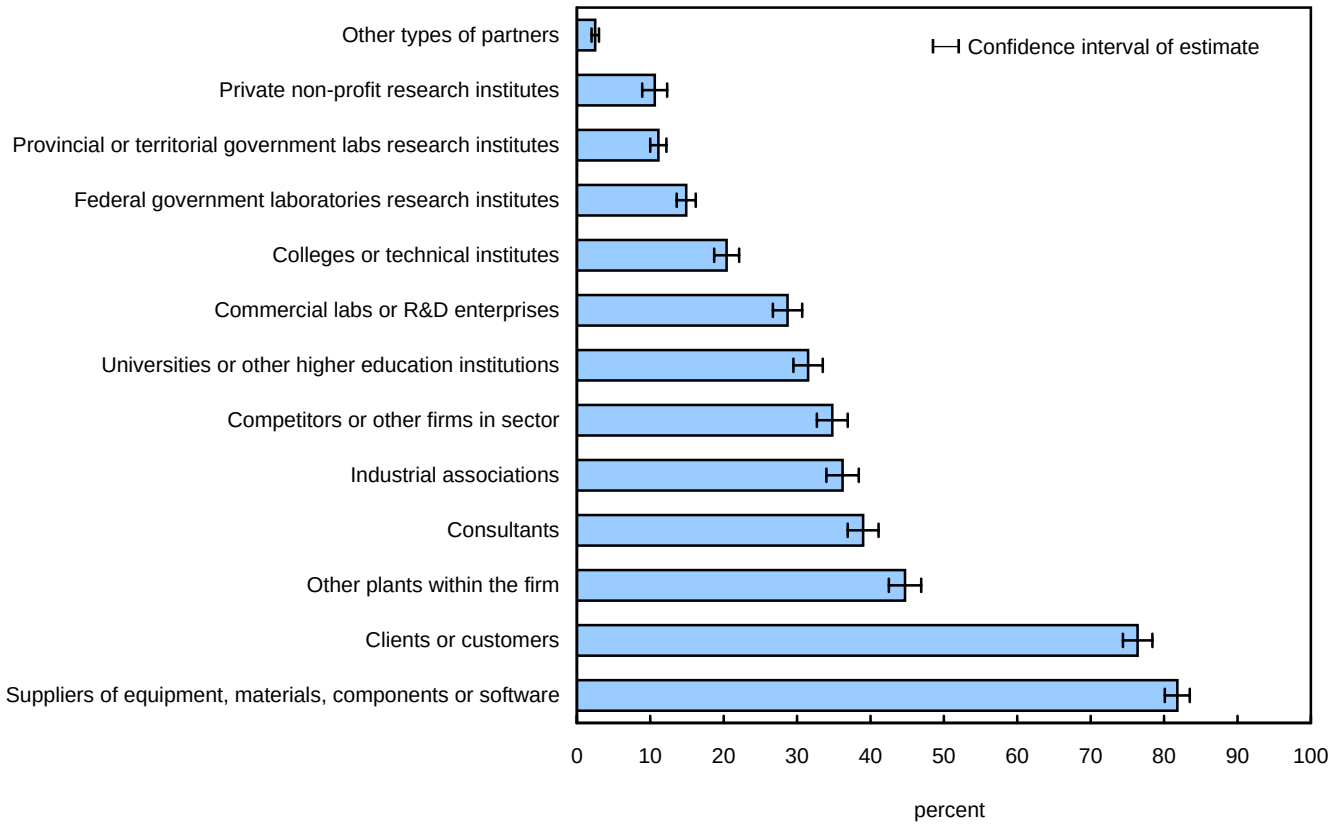
Chart 9
Percentage of collaborating innovative manufacturing plants identifying objectives of collaboration during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0090.

Suppliers of equipment, materials, components or software (81.8%), and clients or customers (76.4%) were the cooperation partners indicated by the highest percentage of innovative manufacturing plants in cooperative arrangements. These are strong relationships that were also identified as important sources of information for the plant's innovation activities.

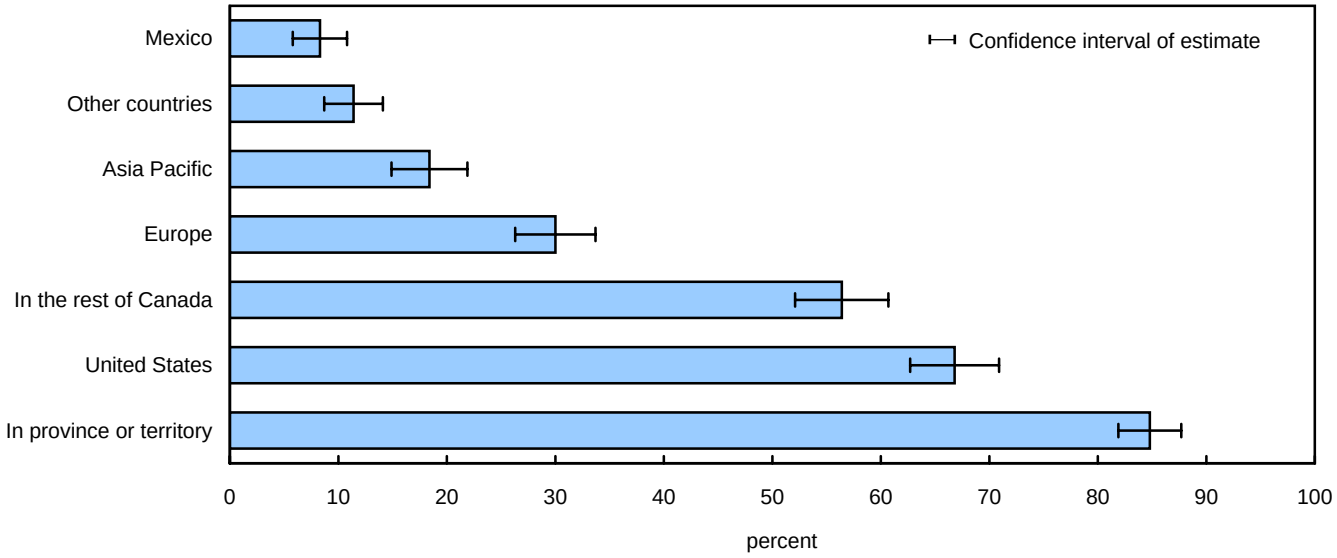
Chart 10
Percentage of collaborating innovative manufacturing plants, by type of collaboration partner during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0092.

Cooperation activities may take place with other plants or firms in a plant's own province or in conjunction with plants or firms across the globe. The majority of innovative manufacturing plants that took part in co-operative arrangements were in collaboration with other plants within their firm, other firms or institutions in their own province or territory (84.8%). Innovative manufacturing plants were more likely to enter cooperative innovation activities with other plants within their firm, other firms or institutions in the United States (66.8%) than they were with other plants within their firm, other firms or institutions in the rest of Canada but outside of their own province or territory (56.4%) (Chart 11).

Chart 11
Percentage of collaborating innovative plants, by location of partner, during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0093.

10 The impacts of innovation

Respondents were asked to indicate the degree of importance[7] for twenty one different impacts of their product (good or service) and process innovations introduced during the three years, 2002 to 2004. Five major types of impacts of innovation were identified in the questionnaire: market impacts; product oriented impacts; process oriented impacts; impacts on the plant; and other impacts.

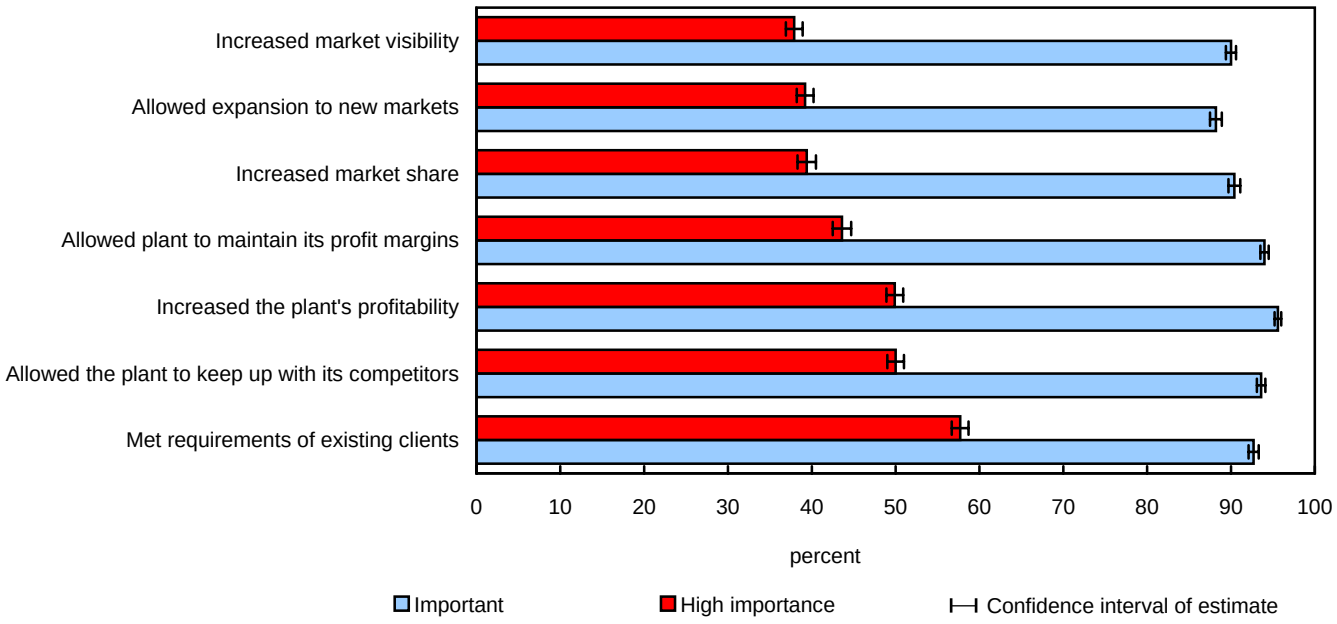
Market impacts of innovation

Each of the seven market impacts were identified by nine out of ten innovative manufacturing plants as important for innovations introduced during the three years, 2002 to 2004 (Chart 12).

Meeting the requirements of existing clients was the market impact indicated by the highest percentage of innovative manufacturing plants as having high importance (57.7%). This was followed by half of plants each indicating that the market impact of innovation was that it allowed the plant to keep up with competitors (50.0%) and that innovation increased the plant's profitability (49.9%).

7. Respondents were asked to indicate the importance as either high, medium or low importance or indicate if an impact was not relevant. The descriptive text portion of this document and the accompanying charts will make a distinction between those impacts deemed of high importance and those that were deemed "important" (either high, medium or low importance).

Chart 12
Percentage of innovative manufacturing plants identifying market impacts of innovation during the three years, 2002 to 2004

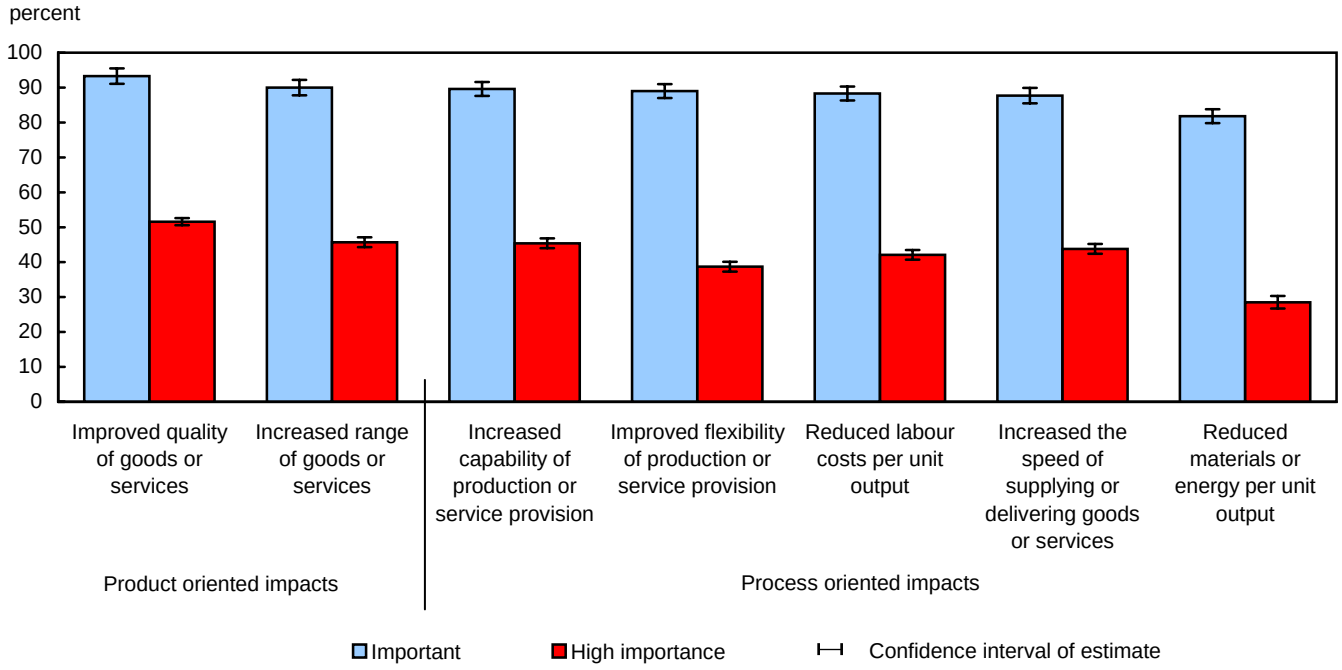


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0095.

Product oriented impacts and process oriented impacts of innovation

More than eighty percent of innovative manufacturing plants indicated that each of the seven product and process oriented impacts of innovation were important. Among these impacts, improved quality of goods or services was indicated as an important impact by the highest percentage of innovative manufacturing plants (93.3%) (Chart 13). This impact was also indicated as having high importance by the highest percentage of plants (51.6%). Reducing materials or energy per unit of output was both indicated as important (81.8%) and as having high importance (28.5%) by the lowest percentage of innovative manufacturing plants among the seven product and process oriented impacts of innovation.

Chart 13
Percentage of innovative manufacturing plants identifying product and process oriented impacts of innovation during the three years, 2002 to 2004



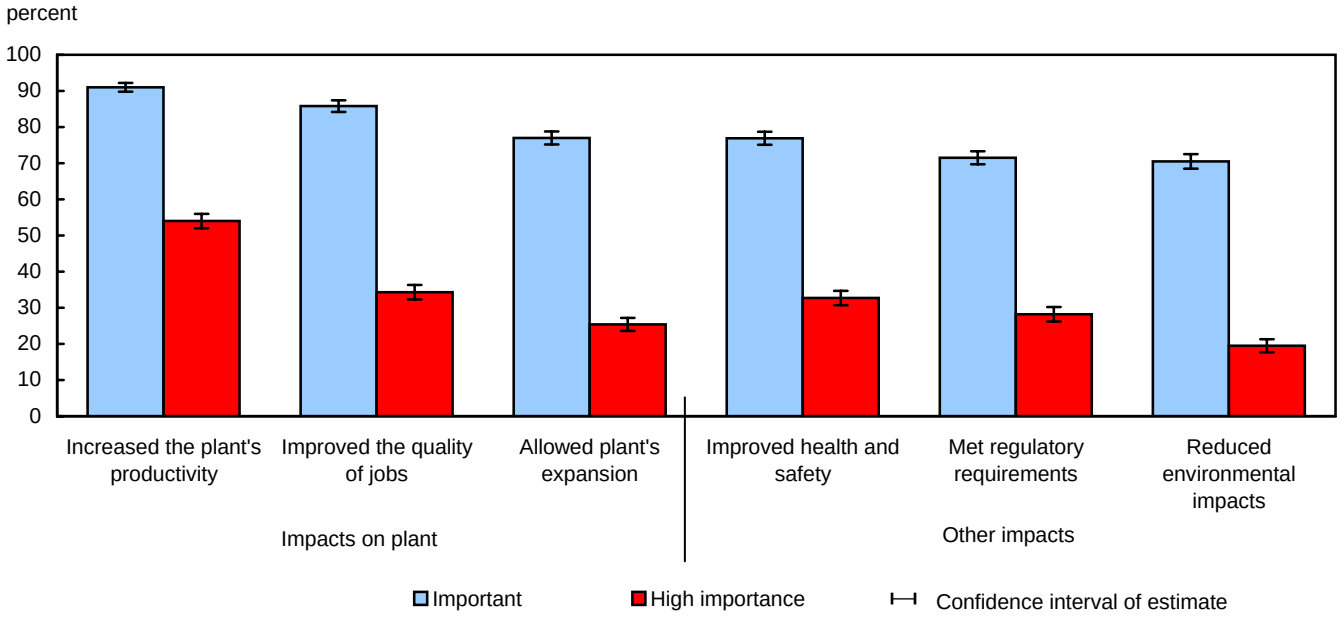
Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0095.

Plant impacts and other impacts of innovation

Nine out of ten innovative manufacturing plants (91.0%) indicated that an important impact resulting from innovations introduced during the three years, 2002 to 2004, was an increase in the plant's productivity. The impact indicated as important by the next highest percentage of innovative manufacturing plants was the improvement in the quality of jobs (85.8%) (Chart 14).

Increasing the plant's productivity was indicated by the highest percentage of innovative manufacturing plants as an impact of high importance (54.0%). Following this, improving the quality of jobs, (34.3%) and improving health and safety (32.7%) were identified as having high importance by the highest percentage of innovative manufacturing plants. Reducing environmental impact was indicated as having high importance by the lowest percentage of innovative manufacturing plants (19.5%).

Chart 14
Percentage of innovative manufacturing plants identifying plant and other impacts of innovation during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0095.

11 Sources of revenue

Three indicators of sources of revenue can be examined for innovative manufacturing plants: other plants in the firm; the plant's most important client or customer; and subcontracts to the plant.

In 2004, an average of 6.4% of the total revenue of innovative manufacturing plants came from other plants in their firm.[8]

In 2004, the most important client or customer (that was not part of the plant's firm) for innovative manufacturing plants accounted for, an average of one quarter (27.5%) of their total revenue.

During the three years 2002 to 2004, one quarter (27.1%) of innovative manufacturing plants indicated they were a subcontractor to other firms or organizations. This work carried out under subcontracting arrangements generated an average of 10.6% of the total value of production for these subcontracted plants in 2004, 10.2% in 2003 and 10.0% in 2002.

12 Obstacles to innovation

Innovative manufacturing plants were asked to indicate the degree of importance of obstacles to the development of innovation and to the commercialization of innovation[9].

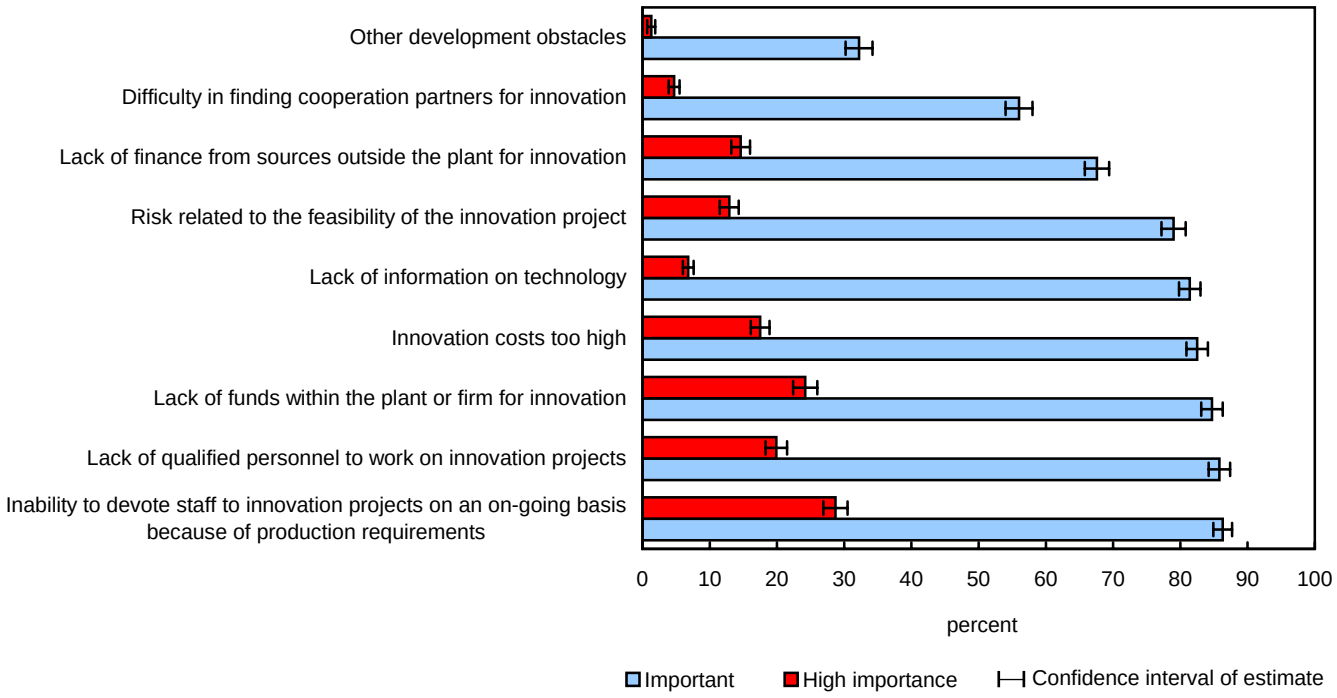
8. Respondents were asked to estimate the percentage of revenue in 2004 that came from other plants in their firm. If the plant was not part of a larger firm, the value was set to zero.
9. Respondents were asked to indicate the importance of the obstacle as either high, medium or low importance or that the obstacle was not relevant. The descriptive text portion of this document and the accompanying charts will make a distinction between those obstacles deemed of high importance and those that were deemed "important" (either high, medium or low importance)

Obstacles to development of innovation

Six out of eight obstacles to the development of innovation were identified as being important by at least four out of five innovative manufacturing plants (Chart 15). Lack of financing from outside the plant for innovation was indicated by two thirds (67.6%) of innovative manufacturing plants followed by difficulty in finding cooperation partners for innovation indicated by 56.0% of innovative manufacturing plants.

Lack of funds within the plant or firm for innovation (24.2%) and inability to devote staff to innovation projects on an on-going basis because of production requirements (28.7%) were most often identified as obstacles of high importance to innovation activities among the eight obstacles to development.

Chart 15
Percentage of innovative manufacturing plants identifying obstacles to development of innovation during the three years, 2002 to 2004



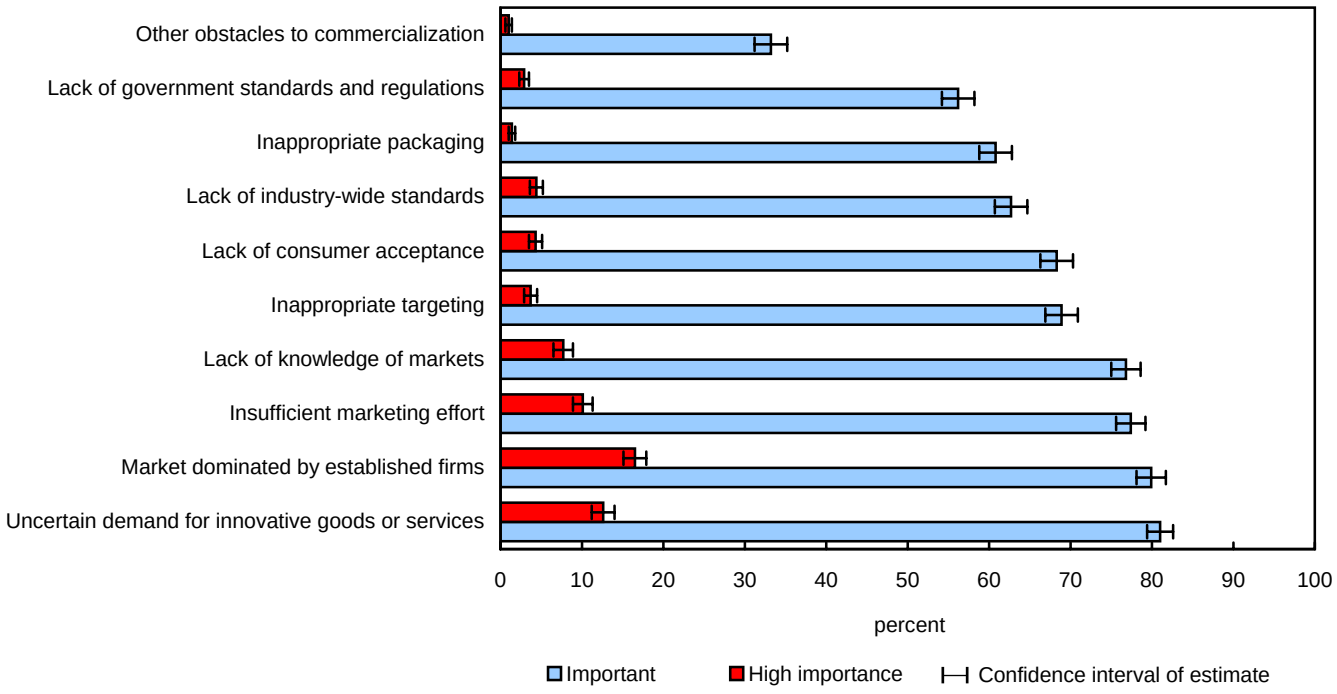
Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0096.

Obstacles to commercialization of innovation

Four of the nine obstacles to commercialization of innovation indicated as being important by the highest percentage of innovative manufacturing plants were: uncertain demand for innovative goods or services (81.0%); a market dominated by established firms (79.9%); an insufficient marketing effort (77.4 %); and a lack of knowledge of markets (76.8%) (Chart 16).

A market dominated by established firms (16.5%) was the obstacle to commercialization of innovation indicated as having a high degree of importance by the highest percentage of innovative manufacturing plants.

Chart 16
Percentage of innovative manufacturing plants facing obstacles to commercialization of innovation during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0096.

13 Use of government programs

Federal and provincial governments sponsor a variety of programs that can promote innovation activities.

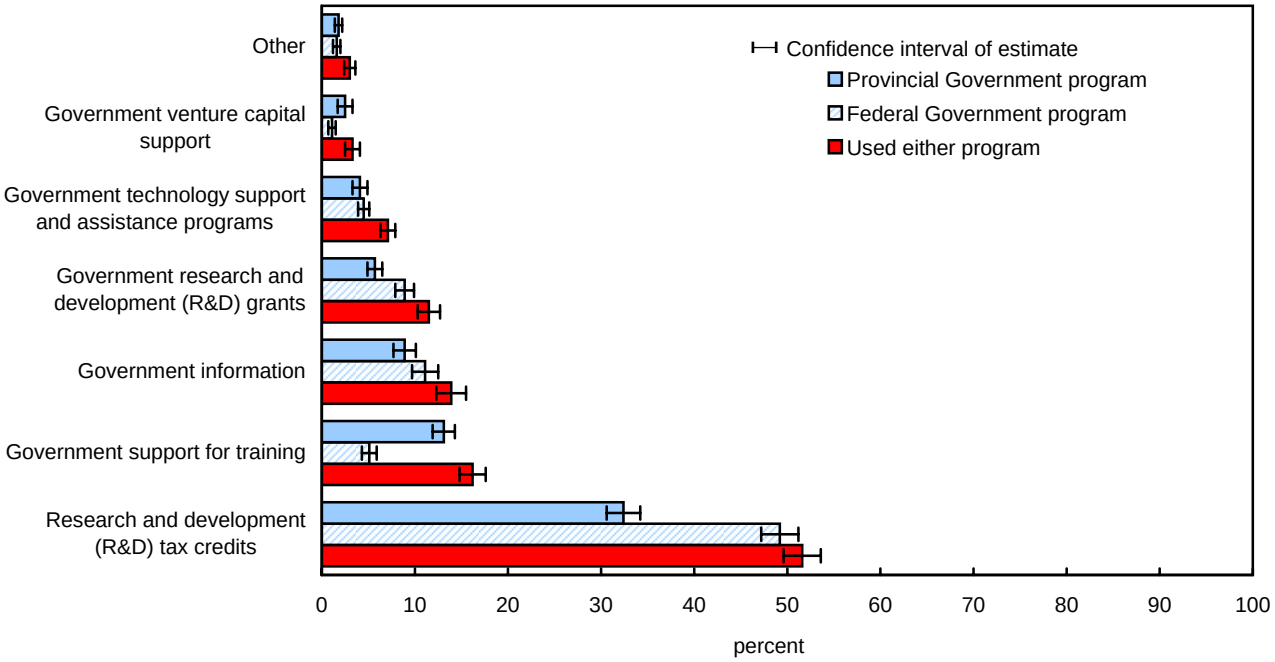
Approximately six out of ten innovative manufacturing plants used at least one of the programs sponsored by the federal government or provincial/territorial governments during the three years 2002 to 2004 (Chart 17).

Research and development (R&D) tax credit programs were used by the highest percentage of innovative manufacturing plants (51.6%) during the three years 2002 to 2004. One-half (49.2%) of innovative manufacturing plants indicated they used federal R&D tax credit programs and one-third (32.4%) of innovative manufacturing plants indicated they used provincial/territorial R&D tax credit programs.

Among federal programs, after R&D tax credits, government information (11.1%) and government R&D grants (8.9%) were the two federal programs indicated as being used by the highest percentage of innovative manufacturing plants.

Among provincial/territorial programs, after R&D tax credits government support for training (13.1%) was the provincial program indicated as being used by the next highest percentage of innovative manufacturing plants followed by government information (8.9%).

Chart 17
Percentage of innovative manufacturing plants that used government programs during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0115.

14 Methods of intellectual property protection

During the three years, 2002 to 2004, 86.0% of innovative manufacturing plants used some method, formal or strategic, to protect their intellectual property (Chart 18).

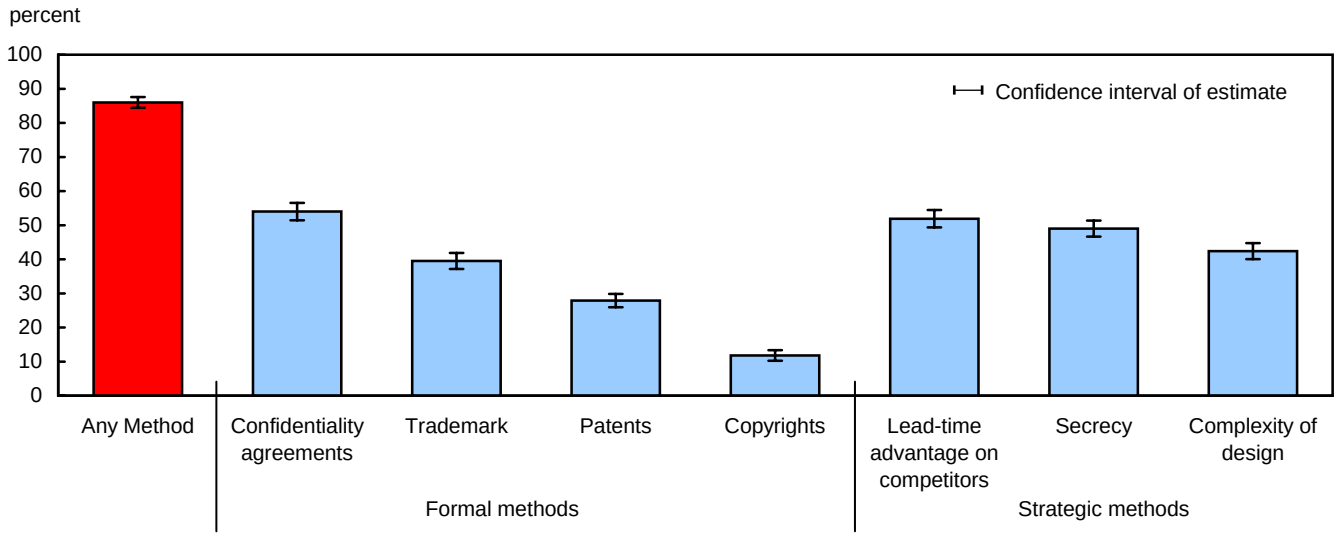
More than two thirds (69.6%) of innovative manufacturing plants used at least one formal method to protect their intellectual property. The most used formal method was confidentiality agreements (54.0%), followed by trademarks (39.5%), and patents (27.9%). Copyrights, indicated by one in ten (11.8%) plants, were the formal method least likely to be used to protect intellectual property out of the four formal methods.

Three-quarters (74.7%) of innovative manufacturing plants used at least one strategic method to protect their intellectual property. The two most indicated strategic methods were lead-time advantage on competitors (51.9%) and secrecy (49.0%). Complexity of design was the strategic method least likely to be used to protect intellectual property (42.4%) among the three strategic methods.

During the three years, 2002 to 2004, one in six (16.9%) innovative manufacturing plants applied for a patent. In terms of their contribution to total revenue in 2004, an average of 7.6% of products were protected by patents in 2004.

In terms of their contribution to total revenue in 2004, an average of 17.4% of products, were protected by trademarks in 2004.

Chart 18
Percentage of innovative manufacturing plants protecting intellectual property, by method, during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0097.

15 Licensing agreements

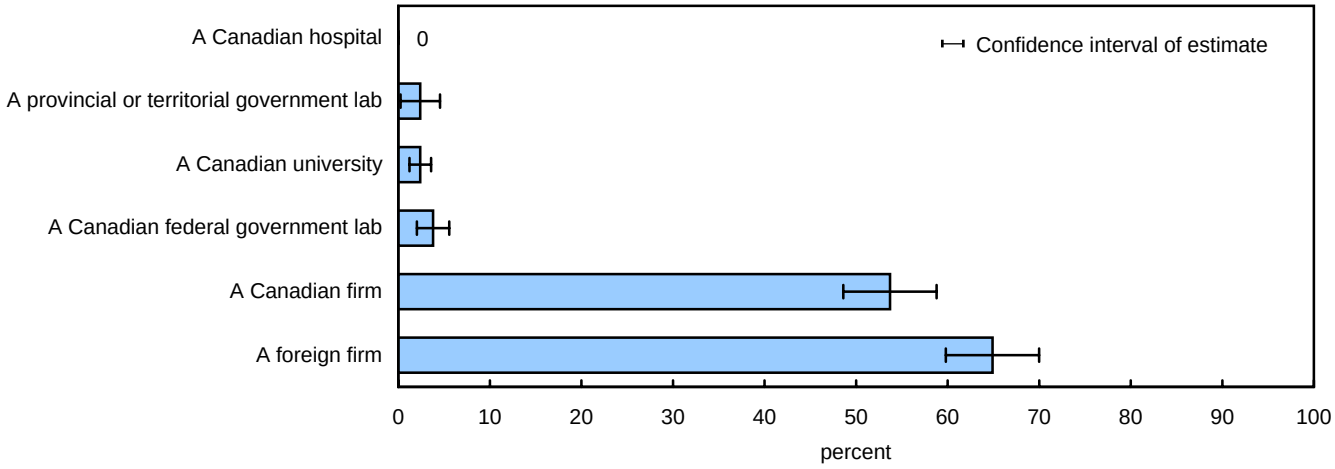
During the three years 2002 to 2004, one in six 16.9% innovative manufacturing plants acquired licenses[10] from other firms or organizations (Chart 19).

Foreign firms were the most likely source of licenses, indicated by two-thirds (66.2%) of innovative manufacturing plants that acquired licenses from other firms or organizations. Half (53.4%) of innovative manufacturing plants that acquired licenses did so from a Canadian firm.

Innovative manufacturing plants were more likely to acquire licenses from other firms than from public institutions: Canadian federal labs (4.3%); Canadian universities (2.7%); and provincial/territorial labs (2.5%). Canadian hospitals were not indicated as a source of licenses.

10. Licenses for software under $1000 are excluded.

Chart 19
Percentage of innovative manufacturing plants acquiring licenses, by source, during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0102.

16 Suppliers to innovative manufacturing plants

The Survey of Innovation 2005 provides information on three types of suppliers to innovative manufacturing plants in 2004: suppliers of raw materials and components; suppliers of machinery and equipment; and suppliers of R&D services.[11]

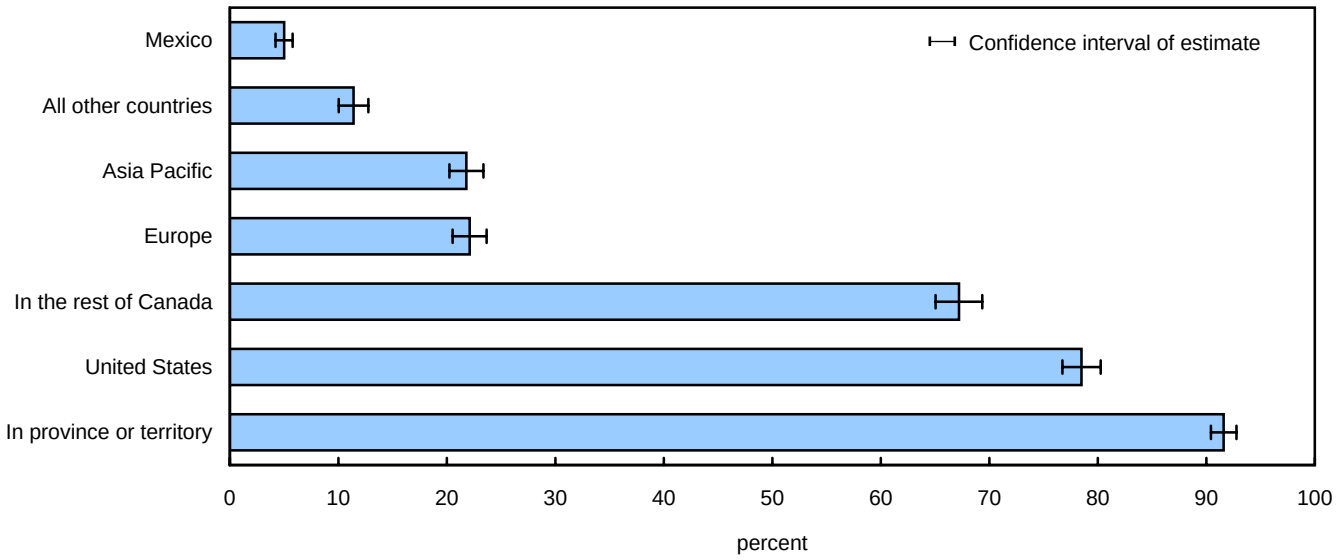
Suppliers of raw materials and components

The majority of innovative manufacturing plants (91.6%) had expenditures on raw materials and components from suppliers in their own province or territory (Chart 20) in 2004.[12] Innovative manufacturing plants were more likely to have suppliers of raw materials and components from the United States (78.5%) than from the rest of Canada (67.2%) and were just as likely to have suppliers of raw materials and components from Europe (22.1%) as they were from Asia Pacific countries (21.8%) in 2004.

On average, one half (51.7%) of total expenditures on raw materials and components by innovative manufacturing plants were in the plant's own province or territory in 2004. There was no difference between the average percentage of total expenditures on raw materials and components supplied from the rest of Canada (16.2%) and the United States (22.4%) in 2004.

11. Respondents were asked to indicate the percentage of their plant's total expenditure on each of the three items that were supplied from seven geographic locations including: the plant's province or territory; the rest of Canada; United States; Mexico; Europe; Asia Pacific; and all other countries. Suppliers were identified when percentages were greater than 0%. For suppliers of raw materials and components, and suppliers of new machinery or equipment, respondents were directed to include suppliers that were part of their larger firm. For contracted out R&D services respondents were asked to not include R&D carried out on their behalf by other plants and R&D units in their larger firm.
12. Respondents were able to select multiple markets from where they had expenditures, the total of the percentages may add to more than one hundred. This also applies to the purchasing of machinery and equipment and contracting out of R&D services.

Chart 20
Percentage of innovative manufacturing plants with expenditures on raw materials and components in 2004, by location

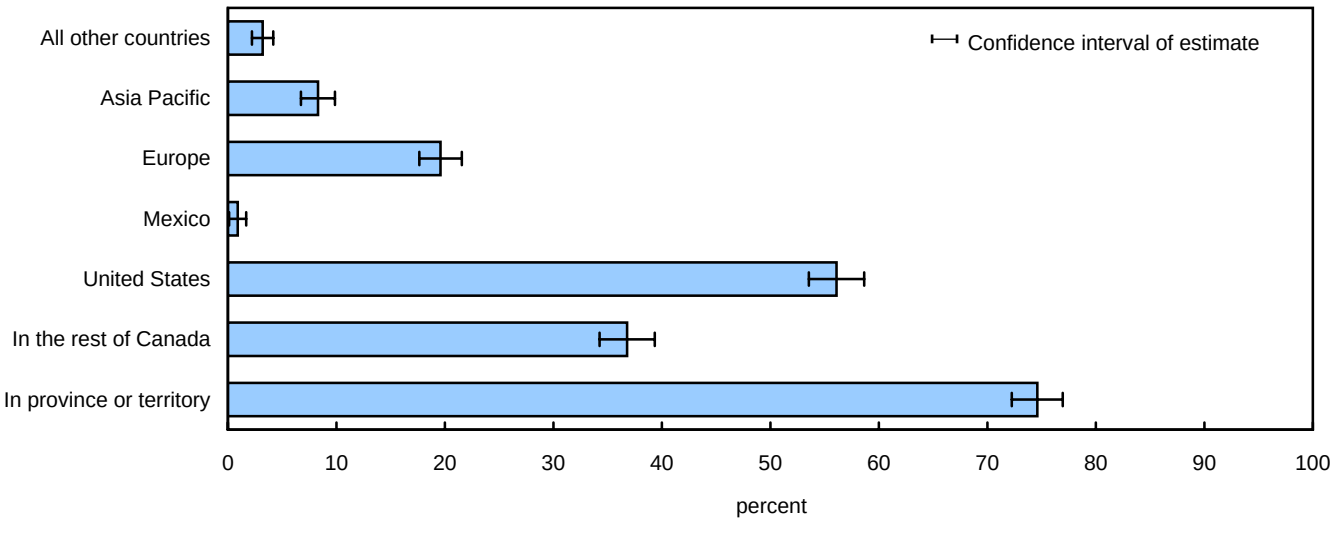


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0104.

Suppliers of machinery and equipment

Among the three out of every four (74.2%) innovative manufacturing plants that purchased new machinery or equipment in 2004, three quarters (74.6%) had suppliers in their own province or territory, one third (36.8%) had suppliers in the rest of Canada and more than half (56.1%) made purchases from the United States (Chart 21). Innovative manufacturing plants were more likely to purchase new machinery or equipment from Europe (19.6%) than from Asia Pacific countries (8.3%) in 2004.

Chart 21
Percentage of innovative manufacturing plants with expenditures on new machinery and equipment, by location, in 2004

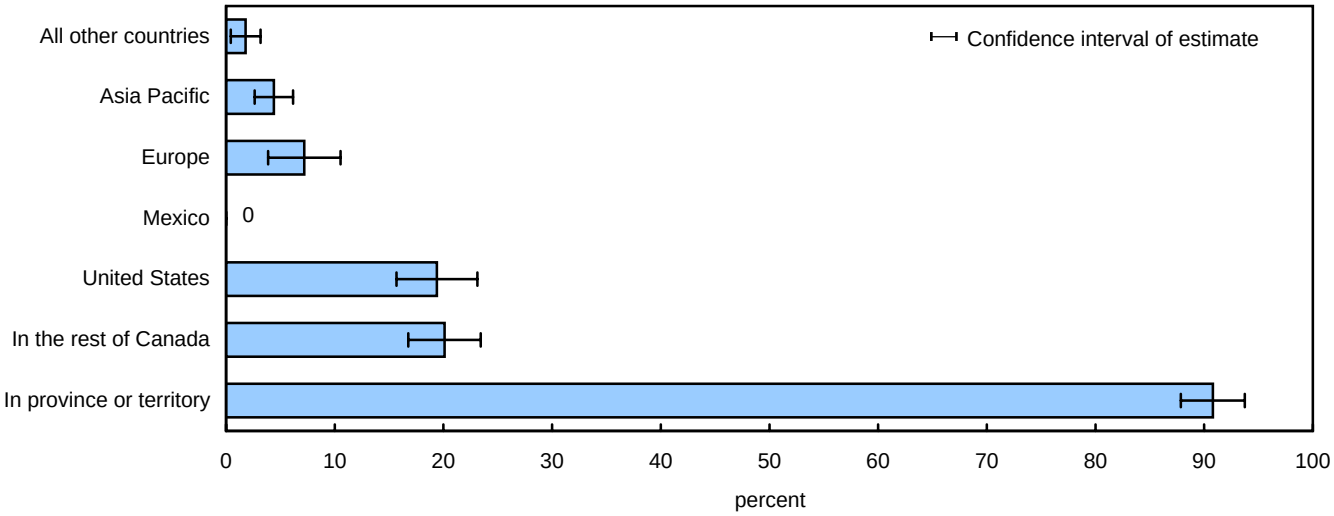


Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0105.

Suppliers of R&D services

Approximately one in seven (14.9%) innovative manufacturing plants contracted out for R&D services in 2004. Nine out of ten plants (90.8%) that contracted out for R&D services in 2004 did so to suppliers in their own province or territory (Chart 22). Innovative manufacturing plants were no more likely to contract out for R&D services to the rest of Canada (20.1%) than to the United States (19.4%) and were just as likely to contract out for R&D services to European countries (7.2%) as they were to Asia Pacific countries (4.4%) in 2004. No innovative manufacturing plants contracted out for R&D services to Mexico.

Chart 22
Percentage of innovative manufacturing plants with expenditures on R&D services, by location, in 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0108.

17 Human resource characteristics of innovative manufacturing plants

Respondents were asked to provide information on the education level of their employees in 2004 and involvement of employees in two specific activities in 2004: R&D activities; and marketing, sales or client services.

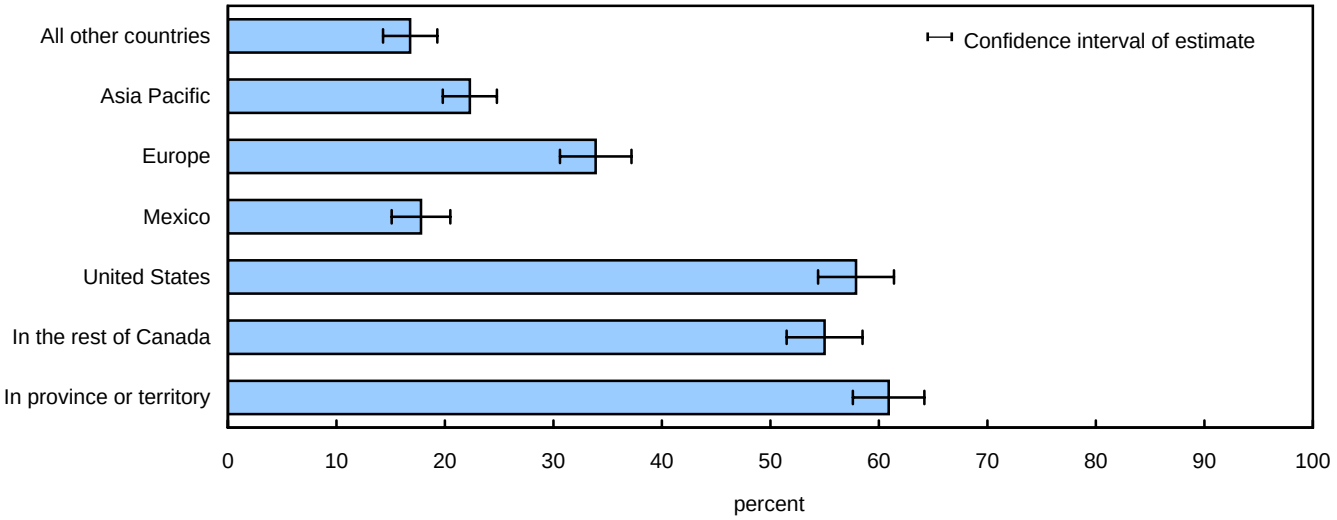
In 2004, an average of one in ten (9.8%) full-time employees in innovative manufacturing plants had a university degree. On average, 17.9% of full-time employees held a diploma from a college or technical institute.

In 2004, an average of one in ten (10.3%) full-time employees of innovative manufacturing plants was involved in research and development activities. In addition, innovative manufacturing plants had an average of one in ten (11.5%) full-time employees involved in marketing, sales or client services.

18 Business characteristics of innovative manufacturing plants

Approximately four out of ten (37.6%) innovative manufacturing plants indicated that they were part of a larger firm. These innovative manufacturing plants were as likely to have other plants or operations in their firm that were located in their own province or territory (60.9%), the rest of Canada (55.0%), or the United States (57.9%) (Chart 23). Innovative manufacturing plants were more likely to have other plants or operations in their firm located in Europe (33.9%) than Asia Pacific countries (22.3%), Mexico (17.8%) or all other countries (16.8%).

Chart 23
Percentage of innovative manufacturing plants that are part of a larger firm, by location of other plants, in 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0064.

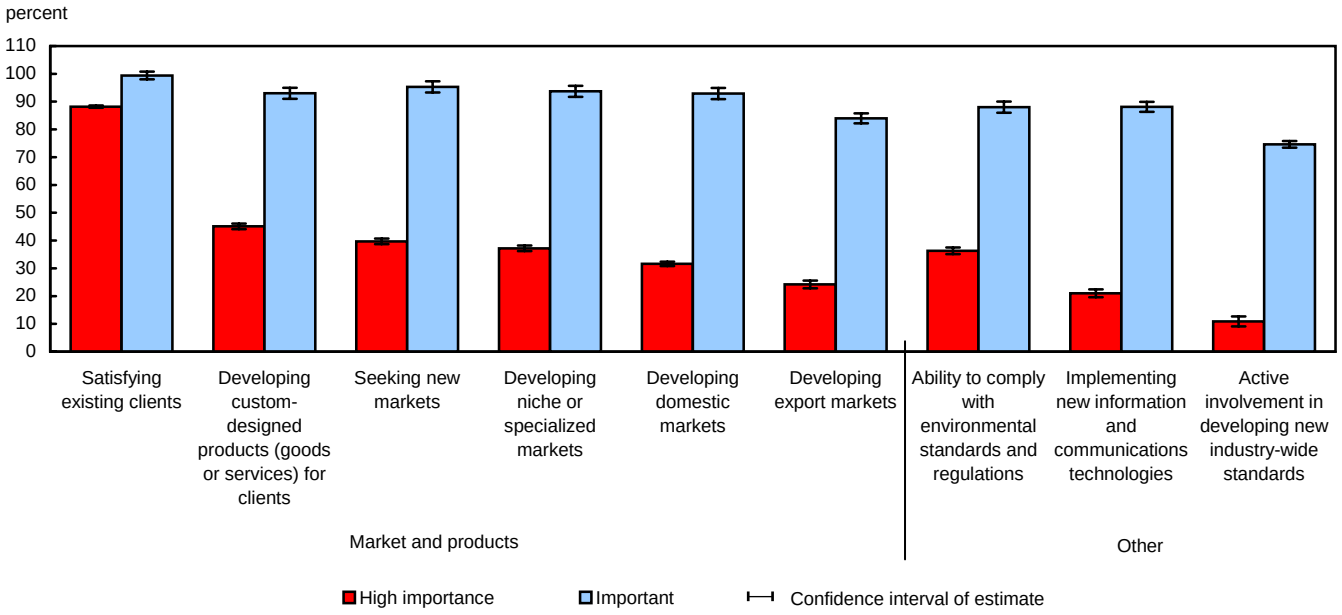
In 2004, one-half (49.3%) of the total revenue of innovative manufacturing plants came from the sale of products (goods or services) to clients in their own province or territory. Innovative manufacturing plants had a greater percentage of total revenue coming from clients in the United States (27.8%) than from the rest of Canada (17.3%).

Five out of six success factors for markets and products were identified by more than 90% of innovative manufacturing plants as being important (Chart 24). Developing export markets was identified as being important by four out of five (84.0%) innovative manufacturing plants. Among the three other success factors not directly related to market and products, approximately nine out of ten innovative manufacturing plants felt that the ability to comply with environmental standards and regulations (88.0%) and implementing new information and communication technologies (88.1%) were important. Three out of four (74.6%) innovative manufacturing plants indicated that active involvement in developing new industry-wide standards was an important success factor.

Satisfying existing clients was identified by nine out of ten plants (88.2%) as being of high importance, the highest level of any of the success factors. Approximately one out of three plants (36.3%) identified the ability to comply with environmental standards and regulations as having high importance, the highest percentage of plants of any success factor not directly related to the market or products.

Chart 24

Percentage of innovative manufacturing plants identifying success factors, by degree of importance, during the three years, 2002 to 2004



Source(s): Statistics Canada, Survey of Innovation 2005. CANSIM table no. 358-0071.

Appendix A — Catalogued publications

Science, Technology and Innovation statistical publications

88-001-X	*Science statistics*
88-003-X	*Innovation analysis bulletin*
88-202-X	*Industrial research and development, intentions (with 2004 preliminary estimates and 2003 actual expenditures) (annual)*
88-204-X	*Federal scientific activities (annual)*
88F0006X	*Business Special Surveys and Technology Statistics Division working papers*
88F0017M	*Science, Innovation and Electronic Information Division research papers*

88-001-X Volume 33 – 2009

No. 1	Biotechnology scientific activities in federal government departments and agencies, 2007/2008 (March)
No. 2	Estimates of Total Spending on Research and Development in the Health Field in Canada, 1997 to 2008 (March)
No. 3	Research and Development Personnel in Canada, 1997 to 2006 (June)

88-001-X Volume 32 – 2008

No. 1	Research and Development Personnel (R&D) - 1996 to 2005 (May)
No. 2	Biotechnology Scientific Activities in Federal Government Departments and Agencies, 2006/2007 June)
No. 3	Estimates of Total Spending on Research and Development in the Health Field in Canada, 1996 to 2007(July)
No. 4	Estimation of Research and Development Expenditures in the Higher Education sector, 2006/2007 (August)
No. 5	Industrial Research and Development, 2004 to 2008 (September)
No. 6	Scientific and Technological Activities of Provincial Governments and Provincial Research Organizations, 2002/2003 to 2006/2007 (October)
No. 7	Federal Government Expenditures on Scientific Activities, 2008/2009 Intentions (November)

88-001-X Volume 31 – 2007

No. 1	Research and development (R&D) personnel in Canada, 1995 to 2004 (January)
No. 2	Estimates of total spending on research and development (R&D) in the health field in Canada, 1989 to 2006 (March)
No. 3	Biotechnology scientific activities in federal government departments and agencies, 2005/2006 (May)
No. 4	Estimation of research and development expenditures in the higher education sector, 2005/2006 (August)
No. 5	Scientific and Technological (S&T) Activities of Provincial Governments and Provincial Research Organizations, 2001/2002 to 2005/2006 (October)
No. 6	Industrial research and development, 2003 to 2007 (November)

No. 7 Federal government expenditures on scientific activities, 2007/2008 (intentions) (December)
No. 8 Gross Domestic Expenditure on Research and Development, 2007 intentions (December)

88-001-X Volume 30 – 2006

No. 1 Distribution of federal expenditures on science and technology, by province and territories, 2003/2004 (February)
No. 2 Biotechnology scientific activities in federal government departments and agencies, 2004/2005 (March)
No. 3 Estimates of total spending on research and development in the health field in Canada, 1988 to 2005 (May)
No. 4 Industrial Research and Development, 2002 to 2006 (August)
No. 5 Estimation of research and development expenditures in the higher education sector, 2004/2005 (August)
No. 6 Federal government expenditures on scientific activities, 2006/2007 (September)
No. 7 Total spending on research and development in Canada, 1990 to 2006, and provinces, 1990 to 2004 (September)
No. 8 Nature of Research and Development, 2000 to 2004 (December)
No. 9 Distribution of federal expenditures on science and technology by province and territories, 2004/2005 (December)

88-001-X Volume 29 – 2005

No. 1 Distribution of federal expenditures on science and technology by province and territories, 2002-2003 (January)
No. 2 Research and development (R&D) personnel in Canada, 1993 to 2002 (May)
No. 3 Biotechnology scientific activities in federal government departments and agencies, 2003-2004 (May)
No. 4 Industrial research and development, 2001 to 2005 (June)
No. 5 Estimates of total spending on research and development in the health field in Canada, 1988 to 2004 (July)
No. 6 Estimation of research and development expenditures in the higher education sector, 2003-04 (December)
No. 7 Federal government expenditures on scientific activities, 2005/2006(December)
No. 8 Total spending on research and development in Canada, 1990 to 2005p, and provinces, 1990 to 2003 (December)

88F0006X Working papers – 2009

No. 1 *Results from the Functional Foods and Natural Health Products Survey – 2007*

88F0006X Working papers – 2008

No. 1 *Innovative Exporters and Intellectual Property Regimes in Selected Service Industries: Evidence from the Canadian Survey of Innovation 2003 (February)*
No. 2 *The Business of Nurturing Businesses (March)*
No. 3 *Understanding Internet Usage Among Broadband Households: A Study of Household Internet Use Survey Data*

88F0006X Working papers – 2007

No. 1 *Innovativeness and Export Orientation Among Establishments in Knowledge-Intensive Business Services (KIBS), 2003 (April)*
No. 2 *Where Are the Scientists and Engineers? (April)*
No. 3 *Results from the Functional Foods and Nutraceuticals Survey - 2005 (May)*

88F0006X Working papers – 2006

No. 1 *Provincial distribution of federal expenditures and personnel on science and technology, 1997/1998 to 2003/2004 (April)*
No. 2 *Buying and selling research and development services, 1997 to 2002 (May)*
No. 3 *Characteristics of Growth Firms, 2004/2005 (May)*
No. 4 *Scientific and Technological Activities of Provincial Governments and Provincial Research Organizations, 2000/2001 to 2004/2005 (July)*
No. 5 *Research and Development in the Field of Advanced Materials, 2001 to 2003 (July)*
No. 6 *Conceptualizing and Measuring Business Incubation (July)*
No. 7 *Characteristics of Business Incubation in Canada, 2005 (July)*
No. 8 *Size and Persistence of R&D Performance in Canadian Firms, 1994 to 2002 (August)*
No. 9 *Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1995 to 2006, and by Province 1995 to 2004 (September)*
No. 10 *Are Small Businesses Positioning Themselves for Growth? A Comparative Look at the Use of Selected Management Practices by Firm Size (October)*
No. 11 *Survey of Intellectual Property Commercialization in the Higher Education Sector, 2004 (October)*
No. 12 *Provincial Distribution of Federal Expenditures and Personnel on Science and Technology (December)*

88F0006X Working papers – 2005

No. 1 *Federal government expenditures and personnel in the natural and social sciences, 1995/96 to 2004/05 (January)*
No. 2 *Provincial distribution of federal expenditures and personnel on science and technology, 1996-97 to 2002-03 (January)*
No. 3 *Industrial R&D statistics by region, 1994 to 2002 (January)*
No. 4 *Knowledge sharing succeeds: how selected service industries rated the importance of using knowledge management practices to their success (February)*
No. 5 *Characteristics of firms that grow from small to medium size: Industrial and geographic distribution of small high-growth firms (February)*
No. 6 *Summary: Joint Statistics Canada – University of Windsor workshop on intellectual property commercialization indicators, Windsor, November 2004 (March)*
No. 7 *Summary: Meeting on commercialization measurement, indicators, gaps and frameworks, Ottawa, December 2004 (March)*
No. 8 *Estimates of research and development personnel in Canada, 1979 to 2002 (May)*
No. 9 *Overview of the biotechnology use and development survey – 2003 (April)*
No. 10 *Access to financing capital by Canadian innovative biotechnology firms (April)*
No. 11 *Scientific and technological activities of provincial governments and provincial research organizations, 1995-96 to 2003-04 (September)*
No. 12 *Innovation in Information and Communication Technology (ICT) sector service industries: Results from the Survey of Innovation 2003 (October)*
No. 13 *Innovation in selected professional, scientific and technical services: Results from the Survey of Innovation 2003 (October)*

No. 14 *Innovation in selected transportation industries: Results from the Survey of Innovation 2003 (November)*
No. 15 *Innovation in selected industries serving the mining and forestry sectors: Results from the Survey of Innovation 2003 (November)*
No. 16 *Functional foods and nutraceuticals: The development of value-added food by Canadian firms (September)*
No. 17 *Industrial R&D statistics by region 1994 to 2003 (November)*
No. 18 *Survey of intellectual property commercialization in the higher education sector, 2003 (November)*
No. 19 *Estimation of research and development expenditures in the higher education sector, 2003-2004 (December)*
No. 20 *Estimates of Canadian research and development expenditures (GERD), Canada, 1994 to 2005, and by province 1994 to 2003 (December)*