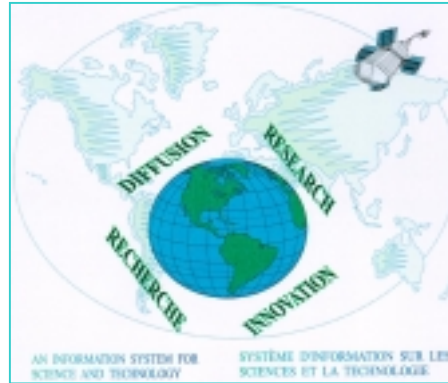




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Survey of Intellectual Property Commercialization in the Higher Education Sector, 1999



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**Survey of Intellectual Property Commercialization in the Higher
Education Sector, 1999**

**By
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88F0006XIB No. 01**

Science, Innovation and Electronic Information Division (SIEID)
Statistics Canada
May 2000
ST-00-01

Symbols

The following symbols are used in Statistics Canada publications:

- .. figures not available
- ... figures not appropriate or not applicable
- nil or zero
- amount too small to be expressed
- e estimated figure
- i spending intentions
- p preliminary figure
- r revised figure
- x confidential to meet secrecy requirements of the Statistics Act

Note: Due to rounding, components may not add to totals.

The Science and Innovation Information Program

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

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

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

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

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

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

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

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

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

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at <http://www.statcan.ca/english/research/scilist.htm>.

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Highlights

During the summer of 1999, Statistics Canada conducted the second Survey of Intellectual Property Commercialization in the Higher Education Sector, which was designed to illuminate the overall process of IP management. Over 100 universities, degree-granting colleges and affiliated research hospitals took part in this voluntary survey. The results show that over 60% of institutions are actively managing (identifying, protecting, promoting and/or commercializing) their IP. Within the last five years, 47% of institutions have filed a patent application and 32% have licensed their technologies, to generate over \$21 million per annum in royalties. Universities also hold \$55 million in equity in their 454 spin-off companies formed to date. The following table provides a summary of the main results.

Table 1. Key statistics on IP management in the Canadian higher education sector, 1999

Revenues from IP management (\$'000)

	Universities	Hospitals	Total
Royalties from licensing*	18,900	2,200	21,100
Grants, etc. (Table 29)	3,670	X	X
Dividends	95	X	X
Total	22,665	X	X

*Some of this amount is shared with researchers.

Expenditures on IP management (\$'000)

	Universities	Hospitals	Total
Operational	21,029	989	22,018
Research parks/business incubators	2,442	X	X
Total	23,471	X	X

	Universities	Hospitals	Total
Revenues minus expenditures	-806	X	X

Assets (\$'000)

	Universities	Hospitals	Total
Equity cashed in, in 1999	X	-	X
Equity remaining (held by the institutions) in spin-off companies	54,560	X	X

Other key statistics, 1999

	Universities	Hospitals	Total
	Number		
Institutions in survey	84	19	103
Institutions actively managing IP	52	11	63
Inventions disclosed	829	64	893
Inventions protected	509	40	549
New patent applications	616	40	656
Patents issued	325	24	349
Total patents held	1,826	89	1,915
New licenses	218	14	232
Total active licenses	1,109	56	1,165
Spin-off companies	454	17	471

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1. Background

The focus on improving national performance and competitiveness in the "knowledge-based economy" has stimulated a new interest in the role of the higher education sector and its contribution to the future economy. The essential roles of universities are still to prepare students for the future and to pursue knowledge in the general interest of the community. Nevertheless, the institutions themselves have also taken on an important role as developers of new technologies with commercial applications.

One of the keys to exploiting the knowledge being generated in universities is the appropriate management of the institution's IP¹. If inventions, ideas and creations are identified and protected, their benefits may be shared by the institution that originated them. Commercializing this IP further ensures that the inventors, creators and their institutions share in the benefits of the work.

Canadian universities have developed their own unique approaches to IP management. This diversity poses challenges to measurement. It requires both an understanding of what the universities do and how they do it.

Prior to this survey, the main source of statistical information on university commercialization activities was the survey conducted by the Association of University Technology Managers (AUTM). This US organization has surveyed major Canadian and US institutions since 1991. Between 12 and 16 major Canadian universities have responded regularly. The survey focuses on licensing but also includes questions on technology transfer personnel and patents.

Several universities have produced studies on their economic impact. The University of Calgary released a study on its economic benefits (Chrisman, 1994) in 1994 and another in 1995 on the influence of its faculty on policy (Unrau, 1995). Both of these were conducted using extensive interviews with university faculty and staff.

In 1997, the University of British Columbia (Livingstone, 1997) released a study of its spin-off companies. The report lists 71 companies accounting for 1,502 jobs.

In early 1997, Statistics Canada commissioned a report by the Impact Group (Statistics Canada, 1997), which recommended a set of 50 indicators to measure the components of the commercialization process. These indicators and the framework from which they were derived (Creating IP, Identifying IP, Protecting and Managing IP, Exploiting IP, Faculty IP Transfer, Company Support and IP Transfer Impacts) served as the basis for the subsequent work at Statistics Canada and for consultations with the universities.

The Association of Universities and Colleges of Canada (AUCC) recommended additional indicators and facilitated discussions with university representatives. The resulting recommendations were used to produce a draft questionnaire, which was subsequently discussed with IP managers in eight universities. The results of the 1998 survey were released in October 1998 and a working paper was published in early 1999 (Statistics Canada, 1999).

¹ **Intellectual property**, for the purposes of this report, is defined as any creation of the human mind that can be protected by law. It includes inventions, works of literature, art, drama and music, computer software and databases, educational materials, industrial designs, integrated circuit topographies, new plant varieties and know-how.

Also in October 1998, the Advisory Council on Science and Technology (ACST) established the Expert Panel on the Commercialization of University Research. The 1998 survey results were used in developing the Panel's recommendations (ACST, 1999). Several of the recommendations were directed at Statistics Canada (see Annex 2) and many were implemented in the design of the 1999 survey.

2. Methodology

The 1999 Survey of Intellectual Property Commercialization in the Higher Education Sector was sent out in May 1999 to:

- all members of the Association of Universities and Colleges of Canada (AUCC)
- all members of the Association of Canadian Teaching Hospitals (ACTH) and
- all other Canadian hospitals reporting R&D activity on the Annual Hospital Survey.

This voluntary survey was first conducted in May 1998 on AUCC members only. The AUCC represents degree-granting universities and colleges, which will be referred to throughout simply as "universities." The 1999 survey covers a total of 84 universities, compared to 81 last year.

2.1.1. Reporting period

Throughout this publication, there are frequent references to the "1999 survey/ this year" and the "1998 survey/last year." The "1999 survey/this year" refers to the most recent survey mailed out in May 1999, covering the institutional year ending between April 1, 1998 and March 31, 1999.

The "1998 survey/last year" refers to the pilot survey mailed out in May 1998. It covers the institutional year ending between April 1, 1997 and March 31, 1998.

3. Data quality

The survey is intended to be a census of all universities and university-affiliated research hospitals. The response rate for universities was excellent but only moderate for hospitals. There is no acceptable method of imputing for non-response to universities, therefore underestimates are noted when they are believed to be significant. The special case of hospitals is discussed in more detail below.

Much of the information that is required to complete the questionnaire does not come directly from university administrative records. Therefore, some estimates were made by respondents. Given the differences between the 1998 and 1999 survey discussed below, we conclude that the variability of these estimates is moderate but improving.

3.1.1. Universities

A number of smaller universities that did not participate in the survey in 1998 elected to do so in 1999. This was no doubt due to higher awareness and interest in IP issues. However, a number of (mainly smaller) 1998 participants did not find it necessary to update their information for 1999. In these cases, the 1998 results were used for the current year. The more important issue is that because this was the second year of the survey, the major universities were able to provide most of the information requested. Therefore, the overall data quality is better.

Most of the 1999 results for the universities show increases over 1998. This is believed to be mostly due to more complete reporting, rather than to increased activity. For one indicator - invention disclosures, this assertion was tested. In 1998, 24 universities reported a total of 661 invention disclosures. In 1999, the same 24 universities reported 668 invention disclosures, an increase of only seven. However, the complete 1999 results show 33 universities reporting 829 invention disclosures. Therefore, the increase in invention disclosures in 1999 is clearly due to more complete reporting.

Throughout the publication, the increases over last year are noted without fanfare and without continually explaining that the reason is believed to be better reporting. In many cases, a complete comparison of the 1998 and 1999 data is provided (e.g., number of universities reporting and the indicator total), in order to assist the reader in the interpretation of the results.

3.1.2. Hospitals

In 1999, the hospitals and other health organizations noted above were sent a separate screening questionnaire to confirm:

- their affiliation with a university
- that they perform R&D and
- that they are in the higher education sector (not private non-profit organizations).

Those institutions meeting the three criteria were asked to complete the same intellectual property questionnaire as the universities. The final response rates were as follows:

Table 2. Response rates

Number	Category
124	Hospitals and other health care organizations (e.g., regional health authorities) to which a questionnaire package was mailed
75	Responses to screening questionnaire received
32	Institutions meeting the three criteria to complete the main intellectual property questionnaire
19	Intellectual property questionnaires returned

The number of non-responses (the gap between 124 and 75 above) is slightly overstated due to hospital restructuring in Ontario. Some hospitals that had merged received multiple questionnaires but only returned one.

Regarding the gap between 32 and 19, some of the hospitals that did not return an IP questionnaire reported only a small amount of R&D. In future surveys a further criteria of a minimum amount of R&D (e.g., \$1 million) could be established.

In 1998, only two universities explicitly included the IP (e.g., inventions protected, patents) from their affiliated research hospitals. Therefore, some of the increased activity in 1999 is due to better coverage of the affiliated hospitals.

In 1999, three universities explicitly included the IP from their affiliated research hospitals. Where possible, the IP was attributed to the hospital rather than to the university. However, the "university" values in this report still include some IP originating in hospitals.

It is also important to note that the hospitals in this survey represent only a portion of the hospitals eligible to complete the main IP survey. (The exact numbers are not known because not

all hospitals returned the screening questionnaire.) Some of the non-participating hospitals are known to be major players in technology transfer. In future, it is hoped that more hospitals will participate.

No attempt has been made to estimate responses for the missing hospitals. Therefore, while these results provide valuable insight into IP commercialization in hospitals, they cannot be extrapolated to reflect all research hospitals.

The term "hospitals" is a simplification used in the text and tables. In fact, the reference is to university-affiliated hospitals, regional health authorities, health research institutes, etc. participating in the survey.

University-affiliated research hospitals are sometimes referred to as "teaching hospitals" but this term was found to be inaccurate. The survey identified 43 organizations that described themselves as "teaching hospitals." Of these, almost all were affiliated with a university but 16 did not do any R&D. The reasons include:

- some universities in smaller centres offer only undergraduate nursing and not the MD degree. Hence, the affiliated teaching hospital may not be involved in R&D.
- some teaching hospitals only teach community college nurses.

The survey also identified a total of 32 university-affiliated hospitals that perform R&D. All but five of these described themselves as teaching hospitals. In three cases, it was because the organization did not even describe itself as a "hospital" but rather as a regional health authority or as an institute within a hospital. However, the other two cases were hospitals that clearly indicated that they were affiliated with a university, did a small amount of R&D but did no teaching.

4. Confidentiality

Most of the tables in this publication separate the university results from the hospital results. The hospital results are shown, except where they are confidential. When this happens, the totals (universities plus hospitals) are also suppressed. This choice was made because the university participation rate was higher than that of the hospitals. It also permits comparison of the 1999 university data with the previous year. Greater participation of hospitals in future surveys will result in fewer confidential numbers and will allow for more complete hospital data and the publication of overall totals.

5. Results

5.1. Infrastructure for IP management

Fifty-eight percent of participating hospitals and 62% of universities (about the same as last year) are actively managing (identifying, protecting, promoting or commercializing) their intellectual property.

Table 3. IP management infrastructure

	Institutions					
	Total Number	Actively managing IP		With central office(s) for IP management		Number of central offices
		Number	%	Number	%	
Hospitals	19	11	58	6	32	6
Universities	84	52	62	50	60	63
Total	103	63	61	56	54	69

One third of hospitals and 60% of universities (compared to 62% last year) have one or more central offices engaged in IP management. Examples of offices include:

- Office of Research Services
- Industry Liaison Office
- Business Development Office and
- Technology Transfer Office.

Note that in some of these offices (e.g., Office of Research Services), IP management may be only one of many functions performed.

The universities that are managing their IP (62% of the total) and those that have a central office engaged in this activity (60% of the total) are virtually the same group. However, in the case of hospitals, 58% of the total have said they are managing their IP but only 32% of the total have a central office engaged in IP management.

The survey revealed that hospitals have different degrees of independence from their affiliated university with regard to IP management. Some refer all IP and technology commercialization matters to their affiliated university. Others commercialize their technology completely independently. Others are quasi-independent. For example, they may have their own Business Development Office but still rely on the university for some aspects of the process. A few hospitals made comments indicating that they were moving toward more independent technology transfer arrangements.

Some of the smaller universities use the technology transfer facilities at larger universities, either those in the same region or with which they are affiliated. This strategy allows smaller institutions to participate in technology transfer at minimum cost. The chief difference between the hospitals and the smaller universities that use outside technology transfer facilities is that the universities are more likely to have also assigned some internal resources to IP management.

In several hospitals, the doctors or other persons involved in research/teaching are cross-appointed to the Faculty of Medicine at the affiliated university. These hospitals indicated that any IP matters would be handled by the university and/or that faculty would have to abide by the university's policies.

Despite the cross-appointments, a number of the hospitals indicated that they had been asked or were in the process of developing their own IP policies. Others said that the issues in the survey had never been raised.

A number of hospitals indicated that they haven't needed an IP policy since they primarily do clinical research e.g., drug testing under contract for pharmaceutical companies. In this case, the pharmaceutical company would own the IP. Statistics Canada's definition of R&D (OECD, 1993)

does not include testing by itself (only testing as part of a larger research activity). Statistics Canada defines R&D as:

"...a systematic investigation carried out in the natural and engineering sciences by means of experiment or analysis to achieve a scientific or technological advance.

Research is original investigation undertaken on a systematic basis to gain new knowledge.

Development is the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes. If successful, development will usually result in devices or processes which represent an improvement in the 'state of the art' and are likely to be patentable."

5.2. Expenditures on intellectual property management

Expenditures on IP management are important in that they provide part of the cost-benefit information for this activity.

Table 4. Expenditures on IP management

	Employees dedicated to IP management	Salaries (corresponding to FTEs)	Patent application expenditures	Legal costs	Other operational expenditures	Total operational expenditures for IP management
	FTEs ¹					
				\$ thousands		
Hospitals	8.5	549	X	X	106	989
Universities	169.1	10,008	5,679	1,499	3,843	21,029
Total	177.6	10,557	X	X	3,949	22,018

¹ Full Time Equivalents

In 1999, universities had \$21.0 million in operational expenditures for IP management, compared to \$17.7 million in 1998. This included \$5.7 million in patent application expenditures, compared to \$5.1 million last year.

Note that some institutions could not separate legal costs from patent application expenditures. In these cases, the amount was reported under the latter.

5.3. Research parks and business incubators

In 1999, there were 18 institutions operating 17 research parks or business incubators. (One park/incubator is operated by two universities.) The same parks/incubators were reported in 1999 as in 1998, with the addition of three new ones operated by hospitals.

Table 5. Research parks and business incubators

	Number reporting	Number of parks/incubators
Hospitals	3	3
Universities	15	14 ¹
Total	18	17

¹ One park/incubator is operated by two universities.

Table 6. Resources devoted to research parks and business incubators

	Institutional expenditures on research parks/business incubators (\$ thousands)	Number of institutional employees devoted to park/incubator activities
Hospitals	X	X
Universities	2,442	21
Total	X	X

Table 7. Researcher requirement to report IP: universities

	Always	Sometimes	Never	No policy on reporting	No such IP at the institution	Total
	Number					
Inventions	27	19	17	11	10	84
Software or databases	14	28	23	16	3	84
Literary, artistic works, etc.	12	22	33	17	-	84
Educational materials	9	30	26	19	-	84
Industrial designs	14	13	23	19	15	84
Trademarks	14	10	20	21	19	84
Integrated circuit topographies	16	10	22	18	18	84
New plant varieties	14	12	17	16	25	84
Know-how	11	15	22	24	12	84

The results for 1999 are similar to those of 1998 if the following points are taken into account:

- On the 1999 questionnaire, there were five response choices (always, sometimes, never, no policy and no such IP at the institution) for each IP type. However, in 1998, only the first three choices were given. Effectively, the 1998 "never required to report" category is now split into two more precise categories: "never" and "no policy on reporting."
- As indicated, the response choice "no such IP at the institution" appeared on the questionnaire in 1999 but not in 1998. In 1998, when many respondents indicated "not applicable" to various IP types, this new response category was artificially and conservatively created. Therefore, it is no surprise that in 1999, when respondents were asked to directly report on whether each IP type was applicable to their institution, that the results are slightly higher.

5.4. Ownership of IP created at the institution

Table 8. Ownership of IP created at the institution: universities

	Institution owns	Researcher owns	Joint ownership	No policy on ownership	Other ownership ¹	No such IP at the institution	Total
	Number						
Inventions	15	36	17	4	2	10	84
Software or databases	10	50	14	4	3	3	84
Literary, artistic works, etc.	-	75	5	2	2	-	84
Educational materials	8	64	6	3	3	-	84
Industrial designs	10	38	9	10	2	15	84
Trademarks	13	34	7	9	2	19	84
Integrated circuit topographies	10	35	10	9	2	18	84
New plant varieties	12	32	6	8	1	25	84
Know-how	7	44	9	10	2	12	84

¹ Includes "the Crown owns the IP" and "varies"

The 1999 survey asked the question "Who owns the IP created at the institution?" The results are shown in the table above.

The results for this question cannot be directly compared to last year because the latter combined two questions: who owns the IP and the percentage of revenue from licensing retained by the institution.

Note that in the majority of cases, the researcher owns the IP. The 1999 question is actually about who owns the IP upon inception. In a number of universities, if the IP is disclosed to and accepted for commercialization by the Technology Transfer Office, the researcher transfers ownership of the IP to the university. This facilitates the commercialization process (e.g., makes it easier to negotiate with outside companies, since the ownership of the IP is not in doubt).

Interestingly, one university stated that the creator(s) own(s) the IP and pointed out that this is not necessarily the faculty member whose name appears on the research grant.

5.4.1. Types of IP found at hospitals

In Question 1.4a of the survey, respondents were asked to indicate one of the following choices for each type of IP:

- Always required to report
- Sometimes required to report
- Never required to report
- No policy
- No such IP at the institution.

Note that the last choice takes precedence over all the others. Respondents were to first consider whether the particular type of IP had ever or could potentially be developed at their institution, based on the types of research conducted there. This is also a useful exercise for universities and hospitals in the process of developing IP policies - to determine for which types of IP they might need a policy.

Some hospitals answered indiscriminately for all IP types, including new plant varieties, which obviously do not result from hospital research. Of the 19 hospitals in the survey, 13 answered as requested. Table 9 shows the applicable IP types reported by this group.

Table 9. Types of IP found in 13 hospitals

Inventions	Software or databases	Literary, artistic works, etc.	Educational materials	Industrial designs	Trademarks	Integrated circuit topographies	New plant varieties	Know-how
Number								
9	12	8	12	6	7	4	-	8

For example, 9 out of 13 hospitals reported that inventions were an IP type applicable to their institution. The category "literary, artistic works, etc." is less obvious but it would include any copyrightable paper, including scientific/medical papers. Note that the only type of IP that all agreed was non-applicable was "new plant varieties." Table 9 shows that hospitals differ substantially as to applicable IP types. Table 10 gives the complete results for requirement to report IP created at hospitals.

Table 10. Researcher requirement to report IP: hospitals

	Always	Sometimes	Never	No policy on reporting	No such IP at the institution	Total
	Number					
Inventions	5	2	-	8	4	19
Software or databases	5	2	-	11	1	19
Literary, artistic works, etc.	2	1	-	11	5	19
Educational materials	4	2	-	12	1	19
Industrial designs	3	1	-	8	7	19
Trademarks	4	1	-	8	6	19
Integrated circuit topographies	3	1	-	6	9	19
New plant varieties	-	-	-	-	19	19
Know-how	3	3	-	8	5	19

Table 11. Ownership of IP created at the institution: hospitals

	Institution owns	Researcher owns	Joint ownership	No policy on ownership	Varies	No such IP at the institution	Total
Inventions	6	4	2	2	1	4	19
Software or databases	9	3	2	3	1	1	19
Literary, artistic works, etc.	6	3	1	3	1	5	19
Educational materials	9	4	1	3	1	1	19
Industrial designs	5	4	1	2	-	7	19
Trademarks	6	3	1	2	1	6	19
Integrated circuit topographies	4	4	-	2	-	9	19
New plant varieties	-	-	-	-	-	19	19
Know-how	6	4	1	2	1	5	19

5.5. Research contracts

A research contract is an arrangement, under which an institution or an individual within an institution, agrees to undertake a specific research project, using the institution's facilities or personnel, for a sponsor that meets all or part of the costs. Research contracts differ from other university funding in that they are usually tied to a pre-specified output (e.g., an invention, book, report). Therefore, intellectual property rights are an important consideration in the negotiation of such contracts. Many university faculty collective agreements have clauses related to research contracts. The table below shows the situation of Canadian universities with regard to who owns the IP resulting from research contracts and who has the first right to licence this IP.

Table 12. Research contract policies: hospitals and universities

Category	Who owns the IP?		Who has the first right to license the IP?	
	Hospitals	Universities	Hospitals	Universities
	Number			
Sponsor	4	5	8	14
Institution	4	15	2	8
Researcher	1	21	1	17
Shared	1	3	-	1
Negotiable/varies/per contract	4	20	3	20
Not applicable/no policy	3	6	3	6
No response	2	14	2	18
Total	19	84	19	84

Table 13 shows the number and amount of research contracts for universities and hospitals in the reference year.

Table 13. Number and value of research contracts: hospitals and universities

	Hospitals		Universities		Total	
	Number	Value (\$ thousands)	Number	Value (\$ thousands)	Number	Value (\$ thousands)
Federal government	X	8,908	1,210	86,926	X	95,834
Provincial or other levels of government	X	X	841	53,251	X	X
Canadian businesses	276	18,097	1,848	107,648	2,124	125,745
Canadian organizations	197	11,887	385	14,831	582	26,718
Foreign governments	X	X	88	8,172	X	X
Foreign businesses	36	X	401	28,036	437	X
Foreign organizations	33	1,245	64	6,117	97	7,362
Other	-	-	58	3,472	58	3,472
Total	699	78,112	5,049	315,246	5,748	393,358

In 1998, universities engaged in 5,081 research contracts worth \$288.6 million. The 1999 survey shows an increase to \$315.2 million in the value of research contracts.

5.6. Barriers to IP commercialization

Fifteen percent of both universities and hospitals are aware of at least one instance where the benefit from IP developed at the institution was realized by a foreign country. Below are the major examples provided by respondents, grouped into themes where appropriate.

- Premature disclosure of IP
 - *"Publication occurred prior to patenting."*
 - *"Disclosure is often a problem due to lack of staff to adequately promote the IP management process to faculty."*
 - *"A researcher prematurely disclosed data to a large US manufacturer. Now there is a case of possible patent infringement."*
 - *"In the case of electronic equipment for biomedical application, published components were incorporated into a US manufacturer's equipment."*
 - *"Researcher provided grant proposal with confidential information to a US company, which then contracted with a US researcher to do the work. The US company provided the Canadian researcher with a \$5k cheque for unrestricted research when we complained to settle the problem."*
 - *"Published before protected. Not unusually, some patent or other IP rights (such as the advantage of confidentiality) are lost as a result of publication or disclosure. Sometimes this is inadvertent and, at other times, the result of a considered decision. Relatively few patents are profitable and in many cases, there may be more to be gained by advancing the discipline through publication than through patenting. In a university, the advance and communication of knowledge are the primary objectives of research and scholarly activity and carry considerable weight when commercialization options are considered. Accordingly, it is to be expected that most products of research and scholarship will be freely disseminated, both within the academic community and beyond. The commercialization option will be preferred in those few cases where it is clearly appropriate and consistent with the multi-faceted mandate of a university."*

- The so-called "brain drain"
 - *"Researcher does research for a foreign company."*
 - *"(IP) directly transferred by researcher to a foreign corporation"*
 - *"Inventors left the university and joined a foreign university."*
 - *"A researcher left the institution before a cessation of his/her rights could be signed."*
 - *"Joint patent with Australia"*
- Other instances of the benefit from IP developed at the institution being realized by a foreign country
 - *" Prior to the establishment of commercialization offices"*
 - *"Licenses to foreign corporations" (comment made twice)*
 - *"The FDA has requirements for manufacturing that artificially prevent Canadian firms from manufacturing RDA-approved products."*
 - *"A narcotics and explosives detection patent was refused funding by the Canadian government for five years. It was eventually funded by the US government."*

Thirty-seven percent of universities and 26% of hospitals are aware of other instances where the institution has not gained the maximum benefit from IP developed within. Many of the responses concern:

- premature disclosure of IP
- lack of IP policies, protection or management
- lack of staff or funds.

Below are some other respondent comments, grouped into themes:

- IP is undervalued
 - *"Socially beneficial IP has been provided at very low cost to cancer agencies."*
 - *"Researchers sign MTAs (biological material transfer agreements) without institutional approval or agree in contracts to give away IP in exchange for materials or research funding. Some researchers have set up companies with venture capitalists for IP developed at the institution, without any sharing of benefits with the institution."*
- Hospital issues
 - *"Our organization sees other benefits, such as patient care or continuing research, as more important in some negotiations. Therefore, maximum financial benefit has been forgone at times."*
 - *"A researcher created his/her own company, owned in part by the University. Now (the Hospital) has to rely on the good will of the University to receive any share of payment."*

- Commercialization problems
 - *"Failure to take account of industry interests"*
 - *"Licensing too early - not doing the value adds"*
 - *"License poorly matched to performance conditions"*
 - *"Dealing with small companies is slow and can be risky due to their financial limitations."*
 - *"(The institution) signed a contract whereby we would collect the royalties for five years. Thereafter, the company would collect the royalties. The company did not develop the product within the first five years."*
 - *"Non-licensed use of invention"*

- Other issues
 - *"...'Maximum benefit to the institution' may not always be the greatest monetary return. The preferences of the researchers (who are essential to any effective technology transfer) must be considered. They may prefer to work with local companies, organizations that will provide collateral benefits in terms of their ongoing research, opportunities for graduate students, real participation in development and commercialization, etc. in preference to those who offer greater economic rewards... One of our researchers is currently facing this issue - comparing the alternative of one of two major US corporations whose interest is known (and from which greater revenues would flow sooner) vs. a relatively new local company..."*

5.7. Identification of new intellectual property

Table 14. Identification of new IP

		Hospitals	Universities	Total
		Number		
1	The researcher is primarily responsible for recognizing the discovery and its potential, reporting it to the institution and requesting consideration for protection and commercialization.	8	53	61
2	The institution strictly monitors the activities of researchers and notes which discoveries should be considered for protection and commercialization.	1	-	1
3	The institution actively solicits opportunities for commercialization and promotes the IP by providing advice and assistance to researchers at various stages.	3	8	11
4	Other means	3	5	8
5	Not applicable/no response	4	18	22
Total number of institutions		19	84	103

In both 1998 and 1999, the predominant approach in universities is still category 1 - the researcher is primarily responsible for reporting IP to the institution. This also holds true for hospitals. Category 3 was added in 1999, after the analysis of the 1998 results showed this major approach to be missing. Categories 1 and 2 were made more distinct, with the addition of the words "primarily" in category 1 and "strictly" in category 2. The 1999 results give a better overview of how IP is actually identified.

Note that several universities reporting category 1 indicated that they would be moving to category 3 in the near future.

The major "other means" are shown below. (Some responses have been paraphrased.) While the survey asked respondents to choose one approach (e.g., presumably the most predominant), some stated that multiple approaches are used.

- *"Both 1 and 3."*
- *"Both 1 and 3. The university requests disclosure of commercial potential at the funding proposal application stage so that our Technology Transfer Office and licensing staff can work with the researchers on a development strategy."*
- *"All three approaches are used."*
- *"Identification occurs by several means:*
 - *researcher may come forward*
 - *Technology Transfer Office does selective monitoring and solicitation and promotes its services*
 - *institutional initiative (e.g., in advance of creation of materials for in-house use)*
 - *peer interaction*
 - *by third parties, who seek out specialists to help solve a problem."*

One hospital elaborated on its category 1 response as follows:

- *"The scientists approach the institution. In many cases, the scientists may also have a company which has approached them. The institution and the company then negotiate an agreement."*

5.8. Faculty consulting activities

Faculty consulting is an important means of transferring IP created at the institution to outside groups. However, it is not always monitored by the institution, as shown in Table 15.

Table 15. Requirement to report faculty consulting

	Hospitals		Universities		Total
	Number reporting	%	Number reporting	%	Number reporting
Required to report faculty consulting					
Always	6	31	24	29	30
Sometimes	3	16	37	44	40
Never	7	37	12	14	19
Consulting not permitted	-	-	1	1	1
Other (unknown)	3	16	10	12	13
Total	19	100	84	100	103

The results for universities are similar to last year. Interestingly, two major universities that indicated "always required to report" also noted that there was "no real control" and that the policy was "not enforceable."

The institutions that indicated "sometimes required to report" were asked to give the relevant conditions. Below are some typical responses:

- *"major paid professional activity"*
- *"if on-going and/or significant"*
- *"during regular working hours"*
- *"on university time or using university resources"*
- *"upon request of Dean."*

5.9. IP management activities

5.9.1. Hospitals

Table 16. IP management activities summary: hospitals

IP Type	Applicable IP Protection activity	Hospitals reporting this IP protection activity in the last 5 years		Hospitals that had disclosures of this IP type in 1998/9	Disclosures in 1998/9	Hospitals engaging in protection activities in 1998/9	Intellectual properties protected in 1998/9
		Number	%					Number
Inventions	Patent application	9	47	9	64	8	40
Software or databases	Copyright registration	4	21	7	10	3	X
Literary, artistic works, etc.	Copyright registration	1	5	3	9	-	-
Educational materials	Copyright registration	4	21	1	X	1	X
Industrial designs	Registration	2	10	-	-	-	-
Trademarks	Registration	6	32	2	X	1	X
Integrated circuit topographies	Registration	-	-	-	-	-	-
New plant varieties	Registration (Canada) Patent (US)	-	-	-	-	-	-
Know-how	License	..	..	1	X	1	X
Various	Non-disclosure or confidentiality agreement	11	58	...	...	...	...
Other IP (cell lines)		..	..	1	X	1	X

5.9.2. Universities

Table 17. IP management activities summary: universities

IP Type	Applicable IP Protection activity	Universities reporting this IP protection activity in the last 5 years		Universities that had disclosures of this IP type in 1998/9	Disclosures in 1998/9	Universities engaging in protection activities in 1998/9	Intellectual properties protected in 1998/9
		Number	%					Number
Inventions	Patent application	40	47	33	829	32	509
Software or databases	Copyright registration	17	20	21	56	6	11
Literary, artistic works, etc.	Copyright registration	26	31	8	360	5	28
Educational materials	Copyright registration	22	26	10	157	4	X
Industrial designs	Registration	6	7	2	X	-	-
Trademarks	Registration	25	30	6	7	7	17
Integrated circuit topographies	Registration	1	1	1	X	-	-
New plant varieties	Registration (Canada) Patent (US)	6	7	4	12	4	30
Know-how	License	..	..	6	14	4	X
Various	Non-disclosure or confidentiality agreement	40	48	...	...	...	...
Biological materials	Transfer Agreement	5	6	-	-	-	-

5.9.3. *Inventions*

Researchers may disclose inventions they have created to the institution, depending on the policy of the particular institution. In 1999, nine hospitals received disclosures of 64 inventions and eight hospitals protected 40 inventions.

Thirty-three universities had disclosures of a total 829 inventions, up from 661 inventions disclosed to 24 universities in 1998. The number of inventions protected was 509. There is no comparable number for 1998.

The question on the number of inventions protected was added in 1999 in order to determine how many of the inventions disclosed to the institution were actually taken under the institution's wing for protection and commercialization. Additionally, some universities included inventions disclosed to them, where the inventor opted not to use the university technology transfer office but to patent independently.

"Protected" means that a protection activity was started. For inventions, "protected" means that a patent application was started. The number of patent applications will usually be higher than the number of inventions protected because one invention may have several patent applications (e.g., for Canada, the US, Europe.) The number of new patent applications filed by universities in 1999 was 616 (Table 18).

In these statistics, it is important to note that the year in which the intellectual property was disclosed is not necessarily the year in which it was protected. For example, in the case of hospitals above, some of the 40 inventions protected may have been disclosed to the institution prior to 1999 but the protection activity was only started in 1999.

5.9.4. *Copyrights*

General

The survey covers three different types of copyrightable IP:

- literary, artistic, dramatic or musical works, books, papers
- educational materials
- software or databases.

Copyright protection is granted automatically in Canada but copyright can be formally registered to establish ownership.

Literary, artistic, dramatic or musical works, books, papers

Note that this title has been shortened to "literary, artistic works, etc." in the tables. The survey asks about registration of copyright of these works, which is not necessary under most circumstances.

In 1999, eight of the smaller universities reported disclosures of 360 literary works. Last year, eight universities had disclosures of 293 literary works.

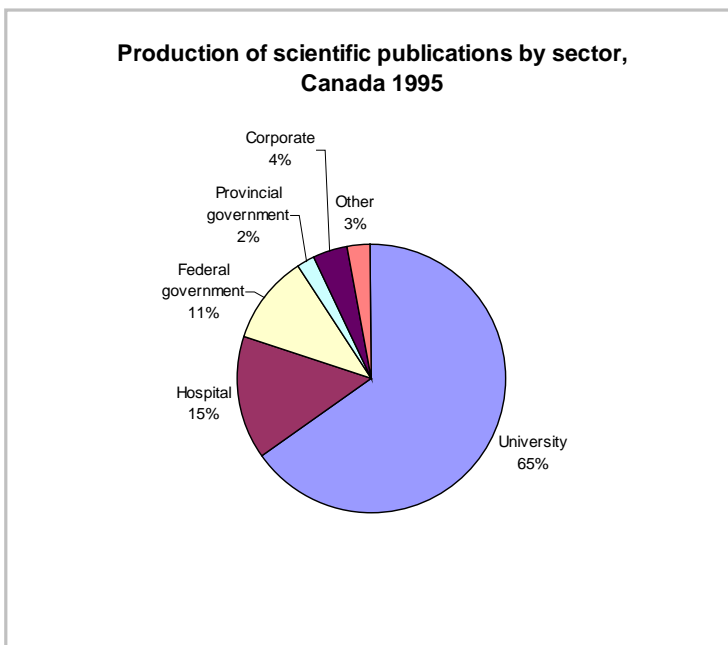
Most universities don't keep records of the number of literary works produced and hence for both years, disclosures were greatly underreported.

Interestingly, one small university had compiled and therefore sent a complete list of publications, which included articles, books, book chapters, book reviews and books edited. It raises the question of what would be valuable to count as IP for this survey, if the larger universities ever decided to keep such records. Perhaps if "literary works" included just the number of complete books (authored but not edited), the universities would find this more meaningful and easier to quantify. After all, books are significant works that generate royalties for their authors.

There may be other works in the category of literary, artistic works, etc., for which the universities have not fully considered the intellectual property implications. For example, in 1998, one university mentioned "commissioned art" as an important type of IP. An artistic commission could be thought of like a research contract. Other types of IP in this category are films, videos, recordings, musical scores, maps, photographs, etc. (However, films, videos, etc. for educational purposes fall into the survey category of "educational materials.")

The category "literary, artistic works, etc." is a slight misnomer in that it includes written works in all subjects, including the sciences. Scientific papers are produced by both hospitals and universities.

The number of scientific papers ("articles, notes and reviews") produced by Canadian universities and hospitals in 1995 was compiled from the Science Citation Index, as part of a bibliometric study supported by Statistics Canada (Godin et al, 1998). According to this study, Canada generated 25,882 scientific publications in 1995, of which approximately 16,800 (65%) were produced by universities and 3,900 (14.9%) were produced by hospitals.



Information from other 1995 indexes, such as the Social Sciences Citation Index and the Arts and Humanities Citation Index, is also available (by institution) from this project.

Educational materials

Ten universities indicated disclosures of 157 educational materials, namely distance education or Internet courses. One hospital also had this type of IP.

Software or databases

Twenty-one universities had disclosures of 56 softwares or databases. However, only six indicated that they had protected a total of 11 softwares. This reflects the fact that copyright is automatic.

Similarly, ten softwares or databases were disclosed to seven hospitals but only three hospitals "protected" their software. One that had not registered a copyright indicated that they considered adding disclaimers and notarizing the date to be forms of protection.

One university also indicated that they had patented, rather than registered a copyright for software. In order to gauge this trend, the question "In the last 5 years, has the institution patented software?" could be added to future surveys.

5.9.5. Industrial designs

In 1999, two universities had disclosures of industrial designs but none were registered. Six universities and two hospitals have registered an industrial design in the last five years.

5.9.6. Trademarks

In 1999, seven trademarks were disclosed to six universities whereas 17 trademarks were registered by seven universities. One reason that the number of trademarks registered is greater than the number disclosed is that some are institutional trademarks and therefore, not necessarily developed/disclosed within the institution. Some trademarks appear to be for use on distance education/Internet course material.

Two hospitals also had disclosures of trademarks and one registered trademark(s).

5.9.7. Integrated circuit topographies

The 1999 results show that only one university has registered an integrated circuit topography in the last five years. None were registered this year or last year. However, a different university did receive disclosure(s) of integrated circuit topography(ies) this year. Therefore, there has been recent activity in this field in two Canadian universities.

No hospitals have registered this type of IP in the last 5 years.

5.9.8. New plant varieties

In Canada, new plant varieties are protected by filing an application for plant breeders' rights. In the US, they are protected by patent.

A claim for protection of plant varieties is preceded by publication of a description of the plant variety in the Plant Varieties Journal.

Six universities have filed an application for plant breeders' rights in Canada over the last five years. Four universities had disclosures of twelve new plant varieties in 1999. Four (not all the same) universities protected a total of 30 new plant varieties.

One university policy makes the following statement about the "intellectual property status of cultivars:"

- *"A cultivar is not an invention. A cultivar is the result of a breeding program. It is the product of parent genetic material, creative input from the developers, labor input, materials and facilities. Each cultivar is the result of a significant amount of development activity, which occurs after an original idea is created. A cultivar may result from an invention but a cultivar is not itself an invention."*

For this university, the end result is that the policy on rights to inventions does not apply to cultivars.

5.9.9. Know-how

In this context, know-how is not general know-how but is related to a patent. According to the Canadian University Intellectual Property Group (CUIPG):

- *"A researcher's know-how can often have considerable value. While it is mandatory in filing a patent application to disclose sufficient information to enable others to reduce the invention to practice, the researcher will often possess valuable confidential know-how and experience to permit commercial optimization of a process or product. Know-how can in fact be licensed independently and a know-how license need not be restricted to the term of the related patent. Confidential information and know-how should, therefore, be clearly defined and disclosures should be covered by a written contract."²*

In 1999, 14 cases of know-how were disclosed to six universities and four universities protected (executed licenses for) the know-how. Know-how was also disclosed to and protected by one hospital.

Table 18. Patenting activities by field of study: universities

Field of study	New patent applications	Patents issued in			Total
		Canada	US	Other countries	
Number					
Commerce, management and business administration	-	-	-	-	-
Agriculture and Biological sciences/ technologies	100	X	33	X	64
Engineering and applied sciences	149	10	42	67	119
Health sciences and technologies	293	X	80	24	X
Mathematics and physical sciences	X	-	X	X	12
All other not elsewhere classified	X	-	X	-	X
Total	616	39	168	112	325

In 1998, Canadian universities reported that they held a total of 1,252 patents from all countries. However, since not all universities could report, this number was understated. The latest results show that 325 new patents were issued in 1999, bringing the total number of patents held to 1,826.

² <http://www.parteq.queensu.ca>. See know-how in "A Guide to Protecting Intellectual Property."

Table 19. Total patents held by country of issue: universities

	Canada	US	Other	Total
	Number			
1998	264	635	353	1,252
1999	355	948	523	1,826

Table 20. Patenting activities by field of study: hospitals

Field of study	New patent applications	Patents issued in			
		Canada	US	Other countries	Total
Number					
Engineering and applied sciences	X	X	X	X	X
Health sciences and technologies	X	X	X	X	X
Total	40	X	X	X	24

In 1999, the hospitals in the survey filed 40 new patent applications and were issued 24 patents. Most of these were in the health sciences and technologies field. (The exact numbers are confidential.)

Table 21 shows that the 19 hospitals hold a total of 89 patents, compared to 1,826 patents held by the 84 universities. Also note that over 50% of the total patents held are for the US.

Table 21. Total patents held by country of issue: hospitals and universities

	Canada	US	Other	Total
	Number			
Hospitals	22	43	24	89
Universities	355	948	523	1,826
Total	377	991	547	1,915

5.10. Activities by size and region

Table 22 shows that the 12 most active universities (those having more than \$50 million in sponsored research income in 1996 according to CAUBO³) accounted for between 60% and 73% of the IP protection and commercialization activities. These activities are moderately less concentrated in the larger institutions than in the previous year. This indicates that the small and medium-sized institutions are taking a larger role in IP commercialization.

³ The universities with more than \$50 million in sponsored research income in 1996/97, as defined in the CAUBO database, are: the University of Ottawa, Queen's University, the University of Guelph, the University of Calgary, Université Laval, the University of Western Ontario, McMaster University, McGill University, the University of Alberta, the University of British Columbia, Université de Montréal and the University of Toronto.

Table 22. Activities of the 12 most active universities

	Universities	Income from sponsored research 1996/97	Royalties from licensing	Invention reports	New inventions protected	Patents held	New licenses	Active licenses	Spin-offs
	Number	\$ millions							
Largest 12	12	1,313	11.5	570	351	1,197	130	813	292
Other universities	72	539	7.3	259	158	629	88	296	162
Total	84	1,852	18.9	829	509	1,826	218	1,109	454
Percent of national total									
Largest 12	14%	71%	61%	69%	69%	66%	60%	73%	64%
Other universities	86%	29%	39%	31%	31%	34%	40%	27%	36%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

There are appreciable differences in regional activities, with BC claiming 39% of all new inventions protected, 30% of patents held, and 30% of all spin-offs but only 12% of new licenses.

Table 23. Activities by region: universities

	Universities	Income from sponsored research 1996/97	Royalties from licensing	Invention reports	New inventions protected	Patents held	New licenses	Active licenses	Spin-offs
	Number	\$ millions							
Atlantic	16	99	X	X	X	X	X	X	X
Quebec	19	507	X	X	X	X	X	X	X
Ontario	24	758	X	X	X	X	X	X	X
Prairies	15	308	X	X	X	X	X	X	X
British Columbia	10	180	X	X	X	X	X	X	X
Total	84	1,852	18.9	829	509	1,826	218	1,109	454
Percent of national total									
Atlantic	19%	5%	--	7%	7%	2%	5%	2%	11%
Quebec	23%	27%	25%	21%	17%	17%	32%	22%	9%
Ontario	29%	41%	19%	30%	23%	26%	24%	25%	31%
Prairies	18%	17%	46%	21%	14%	26%	27%	33%	18%
British Columbia	12%	10%	9%	20%	39%	30%	12%	18%	30%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

5.11. IP promotion

Table 24. IP promotion

	Number of intellectual properties promoted	Number of institutions reporting	Expenditures on IP promotion (\$ thousands)	Number of Institutions reporting
1999				
Hospitals	17	3	X	5
Universities	394	24	1,393	23
Total	411	27	X	28

In 1999, 24 universities promoted 394 intellectual properties, up from 298 the previous year. Promotion expenditures were \$1.4 million, up from \$1.2 million. The average promotion expenditure was \$3,500, compared to \$4,200 the previous year.

A number of respondents indicated that they use the Internet to promote their IP. Several said that they only promote IP that has been assigned to the university. Two said that they only promote technology that is attractive to large markets. One said they use MBA students to develop market studies. In addition, two were organizing workshops for faculty on IP issues.

5.12. Exploiting IP: licensing versus spin-off company formation

When a university or hospital has developed a technology with market potential, there are two basic choices with regard to commercialization:

- license the technology to an existing company
- create a company (a spin-off) to license or further develop the technology.

The decision is based on a variety of factors, such as whether the technology fits into an existing business and the availability of a licensee. A spin-off may be formed if the technology requires further development or prototyping to demonstrate its commercial viability. Licensing can bring in a stable flow of revenues in the short term. However, an institution that spins off a company may take an equity stake in the company in lieu of licensing fees, which can be more profitable over the long term. In general, there is more risk in spinning off a company than in licensing to an existing company but the potential for reward is greater.

5.12.1. Licensing

One third (28/84) of universities have licensed their technologies. In 1998, they had 788 active licenses and in 1999, they executed 218 new licenses. Due to better reporting, the new 1999 total is 1,109 active licenses. Table 25 gives the complete details.

Table 25. Comparison of 1998 and 1999 licenses: universities

	Number of new licenses	Number of active licenses	Number of universities reporting active licenses
1998	243	788	26
1999	218	1,109	28

In 1999, participating hospitals executed 14 new licenses, for a total of 56 active licenses, as shown in Table 26.

Table 26. 1999 licenses: hospitals and universities

	Number of new licenses	Number of active licenses	Number of institutions reporting active licenses
Hospitals	14	56	5
Universities	218	1,109	28
Total	232	1,165	33

Table 27 provides detailed information on new licenses executed in 1999 and total active licenses. One breakdown in the table is the number of exclusive versus non-exclusive licenses. For example, an exclusive license would prohibit the university from licensing the same technology to additional companies.

Another breakdown is the number of licenses with Canadian versus foreign licensees. In section 3.9, recall that two respondents felt that by licensing their technology to a foreign company, that the benefit from their IP was being realized by a foreign country. So an exclusive license with a "foreign" company may be the least desirable option for Canada; an exclusive license with a "Canadian" company may be the most desirable. The table shows that there are 1,109 licenses in effect. Of these, 375 are Canadian exclusive, 168 are Canadian non-exclusive, 153 are foreign exclusive, 294 are foreign non-exclusive and 119 are unclassified.

Table 27. Detailed license data: universities

	Exclusive or sole license	Non-exclusive or multiple license	Unclassified (as to exclusive or non-exclusive)	Total
a) New licenses executed with Canadian licensees that were:	36	3	-	39
i) Sponsors of research contracts or participants in collaborative activities ("Sponsors")				
ii) Not involved in generating the technology licensed ("Non-sponsors")	28	14	-	42
iii) Unclassified (as to sponsor or non-sponsor)	15	13	-	28
iv) Total new licenses with Canadian licensees (a.i. + a.ii +a.iii)	79	30	-	109
b) i) New licenses with foreign licensees	35	51	-	86
ii) New licenses (unclassified as to Canadian or foreign)	-	-	23	23
iii) Total new licenses (a.iv+ b.i+b.ii)	114	81	23	218
c) Active licenses with Canadian licensees that were:	70	23	-	93
i) Sponsors of research contracts or participants in collaborative activities ("Sponsors")				
ii) Not involved in generating the technology licensed ("Non-sponsors")	102	25	-	127
iii) Unclassified (as to sponsor or non-sponsor)	203	120	34	357
iv) Total active licenses with Canadian licensees (c.i. + c.ii +c.iii)	375	168	34	577
d) i) Active licenses with foreign licensees	153	294	-	447
ii) Active licenses (unclassified as to Canadian or foreign)	-	-	85	85
iii) Total active licenses (c.iv + d.i +d.ii)	528	462	119	1,109

Another point of interest in the table is the breakdown of licenses into sponsors and non-sponsors of research contracts. As previously indicated, institutions may enter into research contracts with outside parties, which normally result in IP. Table 12 showed that for 14/84 universities and 8/19 hospitals, the policy is that the sponsor has the first rights to license the IP. Table 27 shows that of 109 new licenses with Canadian licensees, 39 were with sponsors of research contracts/participants in collaborative activities, 42 were with non-sponsors (parties not involved in generating the technology licensed) and the remaining 28 were unclassified.

For confidentiality reasons, detailed information on hospital licenses is not available.

Licensing of technology generates royalties. Table 28 shows the royalties received by universities and hospitals from licensing. Depending on the commercialization arrangement, these are then normally shared with the creators of the IP.

Table 28. Royalties from licensing: hospitals and universities

	Number reporting	Sources			Total
		Canadian	Foreign	Unspecified	
			\$ thousands		
Hospitals	3	X	X	-	2,219
Universities	27	5,945	8,870	4,041	18,856
Total	30	X	X	4,041	21,075

In 1999, Canadian universities received \$18.8 million in royalties from licensing their technologies, up from \$15.6 million in 1998. Hospitals received \$2.2 million in 1999.

Table 29 shows the sources and amount of other significant income from IP commercialization.

Table 29. Substantial sources of income from IP commercialization (other than royalties)

	Hospitals		Universities		Total	
	Number reporting	\$'000	Number reporting	\$'000	Number reporting	\$'000
Reimbursement of patent costs	-	-	4	X	4	X
Sales of IP (database, patent, etc.)	-	-	3	X	3	X
Consulting	1	X	1	X	2	X
Grants (research, etc.)	1	X	5	2,073	6	X
Other	1	X	2	X	3	X
Total	3	X	11 ¹	3,670	14 ¹	X

¹The total is less than the sum (vertically) because four universities reported more than one other source of income.

In 1999, 11 universities reported \$3.6 million in other income from IP commercialization, compared to \$731 thousand reported by eight universities in 1998.

5.12.2. Spin-off Companies

Definition

For the purposes of the survey, a spin-off was defined as a company established for one or more of the following reasons:

Type 1: to license the institution's technology

Type 2: to fund research at the institution in order to develop technology that will be licensed by the company

Type 3: to provide a service that was originally offered through the institution's department or unit.

This survey shows that Canadian universities and their affiliated research hospitals have created a total of 471 spin-off companies to commercialize their technologies. Table 30 shows the distribution.

Table 30. Institutional linkage

	License (Type 1)	R&D (Type 2)	Service (Type 3)	License and R&D	Other combinations	Unknown	Total
Number	215	48	18	28	4	158	471
%	46	10	4	6	1	33	100

Note that 46% of the companies have been established only to license technology developed at the institution (Type 1).

There has been some discussion as to the definition of and the number of spin-offs identified by this survey. The most common comment is that the number of spin-offs is too low or that it is not a true indicator of the impact of university research.

For example, the Industrial Research Assistance Program (IRAP), an arm of the National Research Council of Canada, has identified 741 university spin-off companies, compared to the 471 in the survey. IRAP works directly with entrepreneurs to assist them in starting new

businesses.⁴ The main reason for the difference is that the IRAP number includes companies started by university faculty independently of the university whereas Statistics Canada does not.

The Statistics Canada survey only asks universities to report spin-offs started in a formal arrangement with the university. In most cases, the universities cannot report any other spin-offs (e.g., those started independently by university faculty) because they don't have such records. A number of universities, even those with highly developed technology transfer offices, do not necessarily require faculty to report or commercialize the technology through these facilities.

Another obvious reason why the Statistics Canada survey cannot measure the total impact of university research is that it doesn't cover students, who may gain knowledge at the university, leave and then start up companies on their own.

Below is more information on the 471 spin-offs identified by Statistics Canada.

Table 31. Number of spin-off companies

	Number reporting	Number of spin-offs
Hospitals	4	17
Universities	33	454
Total	37	471

Over two-thirds were created in the 1990s, as shown in the table below.

Table 32. Year of incorporation

	Before 1980	1980 to 1984	1985 to 1989	1990 to 1994	1995 to 1999	Unknown	Total
Number	24	42	60	130	193	22	471
%	5	9	13	28	40	5	100

Of the 471 spin-offs, 68% are active and a further 12% are in the early stage.

Table 33. Status of spin-off companies

	Conceptual stage	Early stage	Active	Merged	Inactive	Closed	Unknown	Total
Number	10	59	319	6	23	26	28	471
%	2	12	68	1	5	6	6	100

Nearly one quarter of the spin-offs are in the health sciences field, followed closely by biotechnology.

Table 34. Technology field

	Biotechnology / biology	Health Sciences	Engineering/ Applied Sciences	Information	Mathematics/ Physical Sciences	Business/ Management	Other/ Unknown	Total
Number	101	114	81	81	59	6	29	471
%	22	24	17	17	13	1	6	100

There are two types of biotechnology: medical and agricultural. Where "medical biotechnology" was specified or if the biotechnology company resulted from hospital research, these were coded under "health sciences." Otherwise, agricultural or unspecified biotechnology was coded as "biotechnology/biology."

⁴ For more information on IRAP, please see <http://www.nrc.ca/irap>.

In 1999, there were 59 spin-offs in the mathematics/physical sciences field, which is fewer than the 73 reported in 1998. (In theory, since the 1999 group of spin-offs includes all the 1998 spin-offs plus some new ones, the 1999 breakdowns for technology field, etc. should be equal to or greater than the comparable 1998 figures.) However, for some spin-offs reported in 1998, more precise information than just "physical sciences" was provided in 1999, which lead to a reclassification of their technology field. This explains the lower number of spin-offs in the mathematics/physical sciences field this year.

Table 35. Equity held in spin-off companies

Spin-offs	With equity held by the institution	No equity held by the institution	Unknown	Total
Number	133	146	192	471
%	28	31	41	100

Table 36. Spin-offs with equity held by the institution, by percentage owned

	1 to 10%	11 to 20%	21 to 49%	50%	51 to 99%	100%	Not known	Total
Number	65	14	13	14	4	11	12 ¹	133
%	48	11	10	11	3	8	9	100

¹ For 12 companies, the institution(s) hold some equity but the percentage is unavailable.

Table 37. Dividends, equity disposition and remaining equity held by institutions in spin-off companies

	Dividends paid to institutions	Equity disposed of (cashed in) by institutions	Value of remaining equity in spin-offs at year end
	\$ thousands		
Hospitals	X	-	X
Universities	95	X	54,560
Total	X	X	X

The value of remaining equity held by universities in spin-offs has doubled, rising to \$54.5 million in 1999 compared to \$22.5 million in 1998. Much of the increase can be attributed to the performance of the stock market in the last year. This is unlike many of the other increases noted in this report, which are mainly due to better reporting.

6. Conclusions

The results of the second Survey of Intellectual Property Commercialization in the Higher Education Sector show that, for the most part, IP management activities are continuing at the same level as the previous year. It is encouraging to note the increased participation and improved reporting. Furthermore, since this was the first time that hospitals were included, significant work needs to be undertaken to improve the response rate and data quality.

This raises the question as to the most appropriate frequency for the survey. If changes occur slowly, then an annual survey may not be required. It is proposed that the next survey be conducted in 2001 and, at that point, that the necessity of an annual survey be reassessed. A one-year hiatus would permit Statistics Canada to conduct detailed analysis of the existing data, and to consult with stakeholders and respondents on questionnaire changes. Detailed analysis could include:

- the economic impacts of spin-off companies (revenues, employment, etc.)
- the nature and economic impact of licensees

- the relative "success" of various IP management strategies (licensing, spin-offs, releasing into the public domain, etc.).

Suggestions are welcome as to other types of analysis that could be conducted using this rich database.

The timing of the survey also needs to be discussed. It is rare for Statistics Canada to have a survey in the field for eight months. However, given the diversity of the academic community, some respondents have time available in May while others prefer to complete the survey in the fall. It is proposed that the 2001 survey be distributed in August, with responses due by late October.

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Annex 1. Differences between the 1998 and 1999 questionnaires

Both the 1998 and 1999 questionnaires are posted on the Statistics Canada Web site under:

Concepts, Definitions and Methods
→ *Questionnaires and data dictionaries*
→ *Science, innovation and electronic information*

- Question 1.1 General Information: no changes
- Question 1.2 Institutions included: no changes
- Question 1.3 Infrastructure for intellectual property management
 - a) "Does your institution have one or more offices...": no changes
 - b) Resources dedicated to IP management:
 - The heading "employees dedicated to IP management" is more specific than in 1998.
 - Components of operational expenditures were added: legal costs, salaries and other operational expenditures.
 - c) "If there is no IP management...": The phrasing was changed to broaden the focus to all universities without IP management.
 - d) The heading "number of *your* institution's employees devoted to [research] park or incubator activities" was made more explicit to avoid inclusion of all research park and incubator staff.
- Question 1.4 Intellectual property policies
 - a) The 1998 questionnaire included three categories for policies on reporting: "always", "sometimes" and "never." The response "never" was valid in several instances:
 - There was a policy explicitly excusing researchers from reporting on the creation of IP;
 - There was no policy on IP reporting;
 - There was no IP of that nature at the university (which was often the case for some of the less common forms of IP).

The wording in the 1999 questionnaire separates these three instances.

The 1998 questionnaire had a section 1.4(b) that asked to whom the reports were to be made. Since there was not much differentiation in the responses (that is, almost everyone who was required to report was required to report to the IP management office), this portion of the question was dropped from the 1999 questionnaire.

- a) and c). During the analysis of the 1998 questionnaire, it became clear that Question 1.4 c) combined ownership and royalties into a single question. Furthermore, the treatment of research contracts was also mixed into the same question. This resulted in some situations that were difficult to interpret upon analysis. For this reason, the 1999 questionnaire has an

explicit section for ownership of IP (b) and royalty sharing (c). It was also made explicit that the policies described in Question 1.4 excluded policies relating to research contracts.

- Question 1.5 Research contracts

- a) The question on policies relating to research contracts was formulated differently. In 1998, this was an open question. In 1999, we asked specifically, who owns the IP and who has the first rights to license it.
- b) Some of the categories of sponsor were made more explicit (for example, "private business" was replaced with "Canadian businesses"), although the intent did not change. "International organizations" was dropped since none of the respondents to the 1998 questionnaire claimed to have contracts with them.

- Question 1.6 Barriers to intellectual property commercialization

- a) The question on benefits lost was made more specific and space was left to describe instances of loss of IP benefits. In 1998, the question asked if the respondent was aware of benefits of IP being lost to the university. In 1999, the questionnaire asked if the respondent was aware of any losses of benefits to another country.

- Question 1.7 Approaches to intellectual property management

- a) The options were reformulated and reworded based on respondent feedback.

- Question 1.8 Faculty consulting activities (no changes)

- Question 2.1 IP reports

"Know-how" was added as an IP type. The wording of the question was also simplified.

- Question 3.1 Past IP protection

The wording of the activities was changed to be more consistent and inclusive. For example, "trade secret agreements" was changed to "signing of non-disclosure or confidentiality agreements."

- Question 3.2 Protection activities

In the 1998 questionnaire, this question asked for the number of protection activities that were initiated during the reference year. It was therefore impossible to count the number of intellectual properties that were accepted for protection. Since Question 3.3 goes into detail about the number of patent applications, the two questions together provide a more complete picture of IP protection activities.

- Question 3.3 Patent applications and patents issued

The field of study was simplified to six categories. The text explains the treatment of international and regional patent applications in more detail.

- Question 4.1 Intellectual property promotion activities (no changes)

- Question 4.2 Licenses

There were minor changes in wording and formatting. Since the handbook provided an explicit definition of Canadian and foreign companies, the term "companies in the United States and foreign countries" was simplified to "foreign licensees."

- Question 4.3 Royalties received (no changes)

- Question 4.4 Technologies licensed (new)

This question was added to trace the economic benefits of the licenses.

- Question 4.5 Other sources of income (no changes)

- Question 5.1 New companies established

In technology sector, minor changes were made to the examples (but not to the overall classification) of spin-offs.

- Question 5.2 Value of dividends (no changes)

- Question 5.3 Amounts received from disposition of equity (no changes)

- Question 5.4 Value of remaining equity (no changes)

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Annex 2. Summary of the recommendations of the ACST Expert Panel on the Commercialization of University Research

1. Statistics Canada should ensure that its voluntary survey covers all Canadian universities and degree granting colleges that secure public research grants. While we appreciate that most (if not all) universities which perform significant amounts of research responded to the inaugural survey, it is important that Canada develop a capacity to undertake longitudinal analysis. If key universities opt out of future surveys, it will be difficult to accurately compare performance over time.
2. The survey should cover Canada's research hospitals since many are affiliated with universities and are involved in collaborative R&D undertakings. We need to better understand their role in the commercialization of research. We understand that a pilot survey to test an appropriate methodology for their inclusion is presently under consideration, and encourage Statistics Canada to move forward on this front.
3. We urge Statistics Canada to explore ways in which it might work with its U.S. counterparts to collect data which will allow for meaningful comparisons of the rate of return on investments in university research.
4. We encourage Statistics Canada to measure the economic impact of university research by collecting not only the names of university spin-off companies, but also established companies entering into licensing deals with universities. Statistics Canada should monitor the performance of these companies using tax data or direct surveys, and report on the revenues they generate, their equity positions, the investments they attract and the jobs they create over an extended period of time. The portion of these gains that are attributable to industry-university collaboration needs to be better understood.
5. In order to shed light on whether empirical data support the assertions of this report, new questions should be added to next years' survey (e.g. legal costs incurred by commercialization offices). Next years' survey should also introduce new questions to investigate more deeply the frequency, magnitude and causes of benefits leaked to other countries.
6. Finally, the survey should publish university-specific information. We appreciate that users are able to work with the raw data, subject to being sworn in under the *Statistics Canada Act*. However, the more data that is broadly available to the research community, the greater the likelihood that researchers will build on the limited academic literature presently available.

These measures would better position researchers to use Statistics Canada data to investigate the following issues, which we believe warrant further study.

- a) Does empirical evidence confirm the propositions put forth in this report (e.g. that universities generate higher returns on investment with lower litigation costs when they own IP or require that IP be assigned to them, require full disclosure, and provide above average resources to their commercialization offices)?
- b) Are firms which form strategic alliances with universities more competitive, and do they create more jobs than firms which do not? Public authorities will continue to face challenges persuading firms to collaborate with universities without empirical evidence on the extent to which various

forms of industry-academic alliances contribute to increased sales and equity, job creation or preservation, and incremental investment.

c) Are certain commercialization pathways (e.g. licensing to established firms vs. creating new spin-off companies) yielding greater economic benefits to Canada? Licences to foreign firms can attract significant investment to Canada; on the other hand, they can result in lost employment opportunities for Canadians. The creation of university spin-off companies is thought to be an effective way to capture all of the benefits in Canada; but successful spin-offs can become prime acquisition targets by foreign multi-national firms. We need a better understanding of the benefits to Canada generated by the various paths to commercialization.

d) To what extent is Canada's approach to commercializing university research contributing to the development of a highly skilled workforce? It will be important to track, for example, the impact of the proposed reforms on the educational choices of our youth, the ability of Canada to attract highly qualified personnel from other countries, and our ability to retain our best and brightest in Canada.

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