

Chapter 3

Section 3.14

University Intellectual Property

1.0 Background

1.1 Definition and Importance of Intellectual Property

Intellectual property refers to creations of the mind such as inventions, literary and artistic works, designs, and symbols, names and images used in commerce. In this audit, we focus on inventions and scientific discoveries made at universities through research activities – for example, new technologies, or new or improved manufacturing processes. If commercialized, such discoveries could have the potential to spur economic growth and enhance Ontarians’ quality of life. Commercialization refers to the process of taking a discovery or invention to the market.

1.2 Ontario’s Research and Commercialization Ecosystem

Research in Ontario is conducted by universities and other organizations, including not-for-profit research institutions and research hospitals. These organizations conduct research alone, in collaboration with other organizations, or in partnership with industry under a contractual arrangement. Funding for research is generally provided to universities through government grants, corporate

and individual contributions, and internal funds of the university, such as endowments and investment income. Only a small amount of research activity results in an invention or discovery. Once a discovery is made, the university can start a process to protect the intellectual property and get it into the hands of private companies, who are generally the ones that commercialize an invention, or bring it to market.

1.3 Provincial Government

1.3.1 Ontario’s Innovation Agenda

In 2008, the province released Ontario’s Innovation Agenda to focus attention on research and innovation as priorities and key factors in economic development. The agenda identified the Ministry of Research and Innovation as the lead responsible for ensuring that the province’s efforts to strengthen its innovation culture are co-ordinated and comprehensive. The goal was to create “a high and sustainable level of prosperity, and healthy communities, that provide high-quality jobs and better lives for people in Ontario.” The agenda highlighted five key objectives, the first of which was to “extract more value from all provincial investments in research and innovation.”

According to the agenda, research in post-secondary institutions, particularly at the

post-graduate level, is central to creating knowledge. However, it noted that industry is often unaware of the intellectual property generated within Ontario research institutions.

1.3.2 Ministry of Research and Innovation

The Ministry's mandate is to support productivity and innovation in Ontario's research, business and entrepreneurship ecosystems, toward building sustainable economic and social prosperity. In 2014/15, the Ministry of Research and Innovation provided \$276 million in research grants to post-secondary institutions, research hospitals and not-for-profit research institutions, of which Ontario universities received 48%. The remainder went to not-for-profit research institutions (39%), research hospitals (12%), and colleges (1%). The Ministry provided an additional \$119 million for commercialization activities (such as, networking events to connect companies with research institutions, access to funding for further development of early-stage technology, and accelerators and incubators that provide space, mentoring and advisory services to start-up companies). In addition, corporate income tax credits—offered to businesses to invest in research and innovation in universities, other research institutions and the private sector—cost the province \$193 million in refundable tax credits in 2014/15 and an estimated \$170 million in forgone corporate income tax revenue in 2014. **Appendix 1** lists the Ministry's key programs that support research activity in Ontario and facilitate the commercialization of discoveries and inventions made in the province.

There are three main research grant programs for universities. *The Research Excellence program* funds direct and indirect operating costs of research that is intended to be transformational and globally significant. *The Research Infrastructure program* funds state-of-the-art equipment and facilities needed to conduct research. *The Early Researcher Awards program* is intended to help recently appointed Ontario researchers build research

teams; its goal is to attract and retain the best and brightest research talent who will train the next generation of researchers and innovators.

The Ministry's commercialization programs are intended to provide services, such as access to capital, business acceleration services, mentoring, training and networking to innovative companies, entrepreneurs and researchers. The Ministry does not provide funding directly to universities to commercialize intellectual property. Instead, funding is provided to a network of organizations called the Ontario Network of Entrepreneurs (ONE). ONE includes the Ontario Centres of Excellence, MaRS, Regional Innovation Centres and Sector Innovation Centres. These organizations in turn fund and/or provide services to universities, colleges and other research institutions, as well as start-ups, entrepreneurs and companies. Since 2013, the Ministry refers to key commercialization activities collectively as the ONE program.

The Ontario Centres of Excellence (OCE) was formally established in 1987 as seven independent centres focusing on commercialization of intellectual property. These centres were amalgamated into one independent not-for-profit organization in 2004 to create productive working partnerships between university and college research departments, research hospitals and Ontario industry, in order to help quality research be utilized to its full potential by industry. It is intended to focus on areas and projects that align with the Ontario's Innovation Agenda and help commercialize research with the greatest potential for economic benefits and/or positive social impact. Aside from the Ministry of Research and Innovation, the OCE is also funded by the Ministry of Government and Consumer Services, federal government agencies and contributions from industry. In 2014/15, the OCE received \$49 million from the Ministry of Research and Innovation to deliver initiatives, including the Industry-Academic Collaboration program, and the Campus-Linked Accelerator program.

MaRS is an independent registered charity which opened in 2005. MaRS works with a network of private and public sector partners to help entrepreneurs launch and grow innovative companies such as start-up ventures. In 2014/15 MaRS received \$17.3 million from the Ministry to deliver initiatives such as the Business Acceleration Program, which supports the growth and development of regional innovation ecosystems across Ontario. MaRS also provides funding to 17 Regional Innovation Centres across the province to provide services such as business mentorship and investor readiness. MaRS also offers programs to college and university student entrepreneurs.

1.4 University Research Environment

Ontario has 21 publicly funded universities, one of which is entirely federally funded (the Royal Military College of Canada). The general purpose of university research is to create knowledge and discoveries that promote university outcomes, develop solutions to address societal challenges, and play a key role in the education experience for both professors and students. Where research results in intellectual property with potential commercial value, universities need to be effective in their commercialization activities and in protecting their intellectual property. Each university has a vice-president of research responsible for managing and co-ordinating the university's research and commercialization activities.

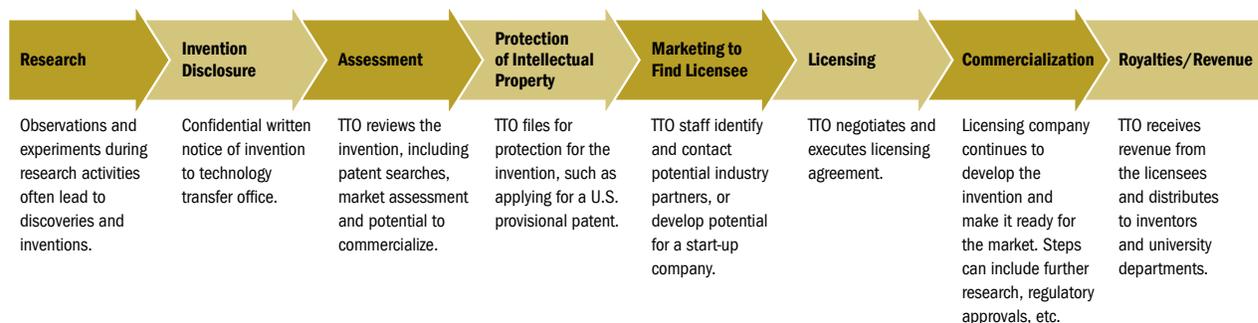
The vice-president of research typically oversees three offices – the research office, the research ethics board, and the technology transfer office. The research office is responsible for facilitating and supporting research activities; the research ethics board sets standards for ethical conduct in every aspect of research and is responsible for ensuring they are maintained; and the technology transfer office helps researchers transfer their discoveries to the marketplace through various activities, such as securing intellectual property protection, evaluating intellectual property for commercial potential, and acting as an agent representing the interests of both the institution and the inventor. Some smaller universities that lack a technology transfer office may use services provided by external technology transfer organizations instead.

Typically, inventors are academics or graduate students who specialize in particular areas of study and lack the time and/or business acumen to take an idea to market. Technology transfer offices are to fill this gap by sharing their expertise and industry connections with inventors, increasing the likelihood that a technology or invention will come to the attention of those most capable of bringing it to market—that is, the industry—and will benefit society. In exchange for this assistance, inventors often agree to give up some or all of their rights to ownership and/or future profits to the university in accordance with the university's policies.

Figure 1 summarizes the typical process of bringing an invention to market (a.k.a. commercialization).

Figure 1: Taking an Invention to Market Through a University's Technology Transfer Office (TTO)

Source of data: Modified from the Stanford University Office of Technology Licensing, *Inventors Guide*



Appendix 2 shows the typical governance structure of a university, with an emphasis on research activity, highlighting the key reporting relationships, roles and responsibilities. **Appendix 3** outlines the mandate for overall research activity and for the technology transfer office at each of the universities we visited.

1.5 Sources of Funding for University Research

Universities receive substantial amounts of funding for research. For their five fiscal years ending in 2014, Ontario universities received \$13 billion in sponsored research funding. As shown in **Figure 2**, the primary funding sources were the federal government (48%), grants or contracted funds from non-government sources (26%), the Ontario government (15%) and other sources (11%).

1.5.1 Federal Funding for University Research

Federally, most university research funding comes from the Tri-Council Agencies, which comprise the Canadian Institute for Health Research, the National Science and Engineering Research Council, and the Social Sciences and Humanities Research Council. Other significant funders are the Canada Foundation for Innovation and Canada

Excellence Research Chairs. In 2013/14, these agencies combined, provided Ontario universities with 80% of total federal funding for research. Some of this funding is intended to help commercialize intellectual property by accelerating the development of promising technology (e.g. covering the costs of building prototypes) or covering the costs of technology transfer activities (e.g. patents, market studies, and networking costs).

Appendix 4 describes the main federal research funding agencies and their contributions to Ontario universities for the fiscal year ending 2014 for universities, the most recent fiscal year for which information is available.

1.5.2 Provincial Funding for University Research

In the fiscal year ending 2014 for universities, 15 provincial ministries provided universities with research funding, according to the Council of Ontario Universities. The largest funding providers were the ministries of Research and Innovation; Health and Long-term Care; Training, Colleges and Universities; and Agriculture, Food and Rural Affairs. **Appendix 5** details provincial research funding to Ontario universities for the five fiscal years ending 2014, the most recent information available.

Figure 2: University Research Funding in Ontario by Source

Source of data: Council of Ontario Universities' annual Financial Report of Ontario Universities, 2009/10-2013/14

Funding Source	2009/10	2010/11	2011/12	2012/13	2013/14	5-year Total	
	(\$ million)	(%)					
Federal government ¹	1,201	1,213	1,223	1,328	1,316	6,281	48
Ontario government ²	362	375	389	480	343	1,949	15
Non-government	396	716	818	747	750	3,427	26
Other Income (e.g., donations, investment income, etc.)	563	167	199	221	232	1,382	11
Total	2,522	2,471	2,629	2,776	2,641	13,039	100

1. See Appendix 4 for federal research funding programs, 2013/14.

2. See Appendix 5 for provincial funding for university research by ministry and agency, 2009/10-2013/14.

Please note, "Fiscal year" denotes that of the university which runs from May 1 to April 30.

1.5.3 University Endowment Funding for University Research

Universities typically have endowment funds. These are restricted to the purposes agreed upon by the university and donors (such as student aid, scholarships and research activity) or as determined by the university's governing council. Endowments are typically invested to preserve the capital in real dollars, adjusted for inflation, with only a set amount of income generated available for use each year. The largest university we visited had research endowment funds totalling \$219 million in 2014, and its annual spending rate was 3% to 5% of the endowment's market value.

Appendix 6 provides a glossary of terms used in this report.

2.0 Audit Objective and Scope

Our audit objectives were to assess whether:

- the Ministry of Research and Innovation has co-ordinated and put effective processes in place to provide research funding to universities, monitor the use of research funding, and assess the benefits to Ontarians; and
- select universities have effective processes in place to manage intellectual property generated from university research, including identifying, protecting, assessing and commercializing intellectual property.

Senior management at both the Ministry of Research and Innovation and the universities we visited, reviewed and agreed to our audit objectives and criteria.

We conducted our audit primarily at the Ministry of Research and Innovation, and at the technology transfer offices of three universities – University of Toronto, McMaster University (in Hamilton) and the University of Waterloo. We selected universities that received significant amounts of research funding; collectively, these

three received almost half of all university research funding provided by the province in 2013/14. As well, in order to observe a cross-section of practices, we selected universities with different intellectual property ownership models and that used different technology transfer offices to facilitate commercialization.

As background for the universities we selected, **Figure 3** shows the world rankings for the three universities visited according to research performance and output, in relation to universities ranked top 10 in the world from 2012 to 2014, and to universities ranked top 10 in Canada in 2014. **Figure 4** shows how the universities we visited ranked in 2014, nationally and internationally, in six fields of research. The rankings are generally based on the number of research articles issued, the number of times the research is cited elsewhere, and whether research articles appear in high impact scientific journals. The University of Toronto ranked first in Canada overall and in the top 100 in the world in all fields of research. McMaster ranked in the top 100 in the world in clinical medicine and social sciences, and the University of Waterloo ranked in the top 100 in the world in engineering.

In conducting our audit, we reviewed relevant documents (including research funding agreements and university policies regarding intellectual property ownership and disclosure requirements); analyzed information; and interviewed appropriate Ministry and university staff. We also obtained research grant information for review from the ministries of Health and Long-term Care; Training, Colleges and Universities; and Agriculture, Food and Rural Affairs. In addition, in April we attended the Ontario Centres of Excellence's Discovery 2015, a two-day conference in Toronto that brought together key players from industry, academia and government, as well as students and entrepreneurs, for networking opportunities. At this conference, we obtained knowledge about services offered by federal and provincial government organizations, such as the Canadian Intellectual Property Office, the Ontario Centres of Excellence, and risk capital

Figure 3: Ranking for Universities Visited Relative to the Top 10 Research Universities Worldwide (2012–2014) and Top 10 in Canada (2014)

Source of data: National Taiwan University Ranking

University	World			Canada
	2012	2013	2014	2014
Harvard University	1	1	1	
Johns Hopkins University	2	2	2	
Stanford University	3	3	3	
University of Toronto	7	8	4	1
University of Washington, Seattle	4	4	5	
University of California, Los Angeles	5	5	6	
University of Michigan, Ann Arbor	6	7	7	
University of California, Berkeley	8	6	8	
University of Oxford	9	9	8	
Massachusetts Institute of Technology	10	10	8	
Canadian Universities				
University of British Columbia	28	27	27	2
McGill University	33	34	33	3
University of Alberta	78	77	79	4
University of Montreal	106	109	86	5
McMaster University	98	118	116	6
University of Calgary	148	151	144	7
University of Ottawa	199	199	161	8
Western University	190	193	206	9
Laval University	225	235	226	10
University of Waterloo	279	256	261	11

Note: The National Taiwan University Ranking, first published in 2007, ranks universities on research performance and output. About 500 universities were ranked worldwide; 22 were in Canada. The ranking is based on an assessment of research productivity (based on the number of research articles) research impact (based on the number of times research articles are cited elsewhere) and research excellence (based on whether the articles appear in high-impact journals).

Figure 4: Top Universities by Research Field, 2014

Source of data: National Taiwan University Ranking

Field	University of Toronto		McMaster University		University of Waterloo	
	World	National	World	National	World	National
Agriculture	38	3	244	16	232	15
Clinical medicine (e.g., psychiatry)	3	1	50	4	n/a	n/a
Engineering	30	1	193	8	65	2
Life sciences (e.g., biology)	11	1	148	7	n/a	n/a
Natural sciences (e.g., chemistry)	30	1	260	8	172	6
Social sciences (e.g., economics)	8	1	54	4	133	10

Note: See Note for Figure 3 for how these were assessed.

programs offered by the Ministry of Research and Innovation. As well, for comparison purposes and to determine whether best practices exist elsewhere, we researched other jurisdictions and analyzed survey results on performance indicators for technology transfer offices collected by the Association of University Technology Managers from many Canadian and U.S. universities. And finally, we reviewed the results of inspections of the administration of research funding by universities by the Canada Foundation for Innovation (a federal research funding agency that, together with Ontario, provides funding for research infrastructure).

Our audit work on the ONE program, including services delivered by the Ontario Centres of Excellence and MaRS, was limited to a review of key performance indicators and results. We also did not look at the universities' administration of research funding.

3.0 Summary

3.1 Provincial Government

In 2008, the government determined that it needed to extract more value from all provincial investments in all research, including from research funding provided to universities. The Ministry of Research and Innovation was made accountable for achieving this objective. However, our audit found that the Ministry does not co-ordinate or track the province's investments in research and innovation. It lacks key information from other research-granting ministries and agencies. As well, it lacks key information from service delivery agents, such as the Ontario Centres of Excellence to which the Ministry provides funding to provide commercialization support to universities. Equally important, the Ministry has not been attempting to measure the extent to which value has been created from these investments.

In our audit, we estimated that in the last five years, at least \$1.9 billion in funding has been provided for university research. This amount excludes Ministry funding provided to service delivery agents (like regional innovation centres) to deliver commercialization services, and tax incentives offered to private companies that invest in university research. Without knowing the payback from either benefits to society or economic benefits through commercialization activities, it is difficult for the government to determine whether it is getting value for money from its significant investment in university research.

Our specific observations regarding the Ministry of Research and Innovation are as follows:

Time to Better Measure Value for Money

- The Ministry needs to develop an implementation plan to monitor whether it is achieving value for money from its investments in research and innovation in accordance with the strategic direction outlined in its 2008 Innovation Agenda. Although some performance measures are in place, this would also involve improving on performance measurement by establishing outcome and potentially socio-economic measures to use in assessing the impact of the Ministry's investments in university research and commercialization.
- The Ministry has a comprehensive selection process for awarding university grants and is generally following its guidelines for awarding these grants. However, it does not subsequently confirm that research outcomes align with those identified in grant proposals.
- In 2009 the Ministry, universities and other stakeholders identified several barriers to commercialization, including a fragmented system of collaboration lacking co-ordination, lack of adequate venture capital and too much regulation and bureaucracy within the commercialization system. In order to address barriers to commercialization, the Ministry

needs to develop a strategy and action plans with timelines to monitor success in breaking down such barriers.

Potential to Benefit Further From Research Funding

- The provincial government has virtually no rights to intellectual property resulting from the research it funds. This is not unusual when compared to a sample of Canadian and international jurisdictions. However, we noted that U.S. Federal government agencies can use inventions made with federal funding royalty-free for their own purposes. We recommended that the Ministry consider the pros and cons of implementing a similar practice in future situations where there may be value to the province. Currently the Ministry of Agriculture, Food and Rural Affairs in Ontario shares in revenue generated by intellectual property created at the University of Guelph with government funds, and a non-exclusive right to use the intellectual property royalty-free for non-commercial internal purposes, perpetually. As a result, it received \$3.3 million in net licensing revenues over the past five years.

3.2 Universities

Ontario universities receive a significant amount of money from governments, private industry and other sources to conduct research. In the five years ending April 30, 2014, universities received more than \$13 billion for research activity from all sources combined. According to past reviews by the Canada Foundation for Innovation, the universities we visited had proper controls in place to manage research funding provided for research infrastructure. We further found that staff working in Technology Transfer Offices at the universities we visited had experience with assessing the commercialization potential of invention disclosures.

However, universities' technology transfer offices have the opportunity to make some improvements in a few research and intellectual property oversight areas as follows:

Time to More Fully Measure Value for Money

- While universities do track key commercialization indicators and results of their technology transfer offices, they do not yet measure the socio-economic impact of their research activities and commercialization efforts. It may be time to take on this challenge to further confirm value for money is being achieved.

Opportunity to Better Protect and Benefit From Intellectual Property

- Patent protection may not always be taken out on a timely basis at the universities, increasing the risk that others may obtain a patent based on publicly communicated information about the invention. At three universities we visited, the average time ranged between 80 and 188 days for a U.S. provisional patent and between 25 to 211 days for all other types of patent filings.
- None of the Technology Transfer Offices we visited highlighted revenue generation as one driving force. In most years they spent more to operate their office than they gained from intellectual property holdings, before distribution to inventors and other parties. We also noted, that although universities had a significant number of active licences at the year ending April 30, 2013, the number of licences that generated income varied – only 3% at one university, 25% at another and 44% at the third. Comparatively, the average income from licences at Canadian universities was \$61,000 and the average income from licences at U.S. universities was \$130,000.
- None of the technology transfer offices we visited had formal guidelines or policies on

managing costs associated with commercialization efforts. As well, in a number of cases there were delays in the collection of revenues from intellectual property revenue generating agreements.

- From our review of files in technology transfer offices, documentation was not available to confirm that formal processes were used to assess the feasibility of commercialization and track decisions/actions being taken.

Although our findings relate specifically to the three universities we visited, we encourage other universities across Ontario to review our recommendations, as noted in **Appendix 7**, and act on those that may apply to their individual circumstances.

This report contains 15 recommendations, consisting of 27 actions to address the findings noted during this audit.

OVERALL MINISTRY RESPONSE

The Ministry of Research and Innovation is in agreement with the Auditor General's recommendations stemming from the audit on University Intellectual Property. The Ministry plans to take action to address those directed to it.

The 2008 Ontario Innovation Agenda provided a strategic framework for Ontario. The Ministry has been using this framework to guide its activities. To help with commercialization and innovation, the Ministry also has the Ontario Network of Entrepreneurs (ONE), which is a network of 90 centres across Ontario that provide in-person and online advice, referrals, programs, funds, resource materials, training and connections for people who want to start and grow successful businesses.

The Ministry supports research excellence and talent development through its programs. The Ministry appreciates the Auditor General's recognition that we have a comprehensive selection process for awarding university grants with over 75% of funding decisions being aligned

with Ontario's Innovation Agenda. In addition, four of the top 10 Canadian research universities are located in Ontario, including the University of Toronto, McMaster University, the University of Ottawa and Western University. However, the Ministry recognizes that further improvements are needed to be able to better measure the benefits to Ontarians.

The Ministry will continue to assess and refine the programs it offers to support innovation in Ontario.

4.0 Detailed Observations

4.1 Government Research-related Investments and Activities

4.1.1 Lack of Co-ordination of the Province's Investments in Research and Innovation Activities

The Ministry Is Not Tracking Total Funding for Research and Innovation Province-wide

Ontario's 2008 Innovation Agenda recognized that a wide range of ministries and agencies carry out the government's innovation-related investments and activities, including research funding. It identified the Ministry of Research and Innovation as the lead ministry responsible for ensuring that Ontario's efforts to strengthen the province's innovation culture are co-ordinated and comprehensive. However, during our audit, we found that the Ministry was still not effectively co-ordinating the province's investments in research and innovation activities.

In particular, the Ministry did not know the total amount of provincial funding provided annually, either directly or indirectly, for research and commercialization activities. To illustrate:

- Although the Ministry was able to provide us with a list of the research-granting programs that it managed, it was not able to provide us with a comprehensive list of

provincial programs from across all government ministries and agencies that fund research. We would expect that, because it is the lead ministry, the Ministry of Research and Innovation would be the custodian of comprehensive financial information on all provincial government funding programs for research and innovation. Using information collected by the Council of Ontario Universities, we determined that the total amount of provincial funding provided to universities for research activities was at least \$1.9 billion for the 5-year period ending April 30, 2014 (see **Appendix 5**). However, this is not the total amount the provincial government spent on research and innovation. It does not include research grants it provided to not-for-profit research institutes, research hospitals and colleges, as well as ministry funding provided to service delivery agents (like regional innovation centres) to deliver commercialization services, and provincial tax incentives offered by the Ministry of Finance to private companies that invest in university research.

- The Ministry does not provide funding directly to universities for commercialization activities. Instead, the Ministry makes transfer payments to the Ontario Centres of Excellence and MaRS, which provide commercialization support to universities. During our audit, we noted that the Ministry has not tracked or asked the Ontario Centres of Excellence and MaRS to provide details on the funding or assistance given to universities.

We also noted that the Ministry does not always know whether the research it has funded has resulted in intellectual property. Recipients of research funding submit their final performance report to the Ministry in the last year of funding, noting any accomplishments to date. However, where there is research value or impact, it likely occurs years later following commercialization efforts by the university technology transfer offices,

and long after the initial funding agreement's reporting requirements have ended.

Further, the Ministry does not have a process in place to make other ministries aware of new technologies and innovations developed with provincial funding. It does not track if government ministries or agencies, who had initially indicated support for a research project, are using inventions that may have resulted from the research or are benefitting in any other way from funding provided. Applicants for research funding are encouraged to submit letters of support with their research proposals to secure funding. These letters are generally from the private sector, but in some cases they may be from government ministries and agencies with which researchers have established contact. The Ministry of Research and Innovation informed us that the onus to follow up on those research outcomes rests with the ministries and agencies providing the letters of support.

RECOMMENDATION 1

As the lead ministry in ensuring Ontario's efforts to strengthen its innovation culture are co-ordinated and comprehensive, the Ministry of Research and Innovation should establish processes to track and monitor the total direct and indirect provincial funding for research and innovation and the new technologies and inventions resulting from that funding.

MINISTRY RESPONSE

The Ministry agrees to evaluate methods to track and monitor total direct and indirect provincial funding for research and innovation and the new technologies and inventions resulting from that funding.

For example, in the 2015 Budget, the government committed to implementing a common registration process for all transfer-payment recipients. This enables insight into and oversight of the full financial relationship between the government and service delivery partners.

When fully implemented, this will facilitate accurate and complete aggregation of information detailing the funding relationship that the province has with transfer-payment recipients, including institutions receiving research and innovation funding.

No Plan Developed to Implement the 2008 Innovation Agenda

The Ministry has not developed a broad-based and multi-year plan to implement the strategic direction outlined in the 2008 Innovation Agenda. The Innovation Agenda was a strategy for research and innovation which identified key sectors of the economy for investment where Ontario had a strategic advantage and global position. It did not serve as an implementation plan since key initiatives, formal deliverables, timelines and targets were absent from the Agenda. A more detailed plan would provide for a measure of oversight to ensure action was taken within assigned timelines.

Since the release of the Innovation Agenda in 2008, the Ministry has issued three additional strategic planning documents that relate to specific sectors: Ontario's Life Sciences Commercialization Strategy (2010), Ontario Cleantech Asset Map (2010), and Ontario's Water Sector Strategy (2014). While these documents provide strategic direction, they do not serve as implementation plans since they lack detail on all the key initiatives, deliverables, performance measures and targets that would be useful to implement these strategies.

RECOMMENDATION 2

The Ministry of Research and Innovation should develop and implement a multi-year plan to cover the Innovation Agenda's strategic direction as well as provincial goals and initiatives on research and innovation. This plan should provide enough detail to clearly summarize the deliverables, and establish timelines and targets to deliver on key strategies, initiatives and research and innovation programs.

MINISTRY RESPONSE

The Ministry agrees to develop and implement a multi-year plan to cover the Innovation Agenda's strategic direction as well as provincial goals and initiatives on research and innovation.

Although the Ministry did not have a formal multi-year plan linked specifically to the Innovation Agenda, the Ministry has implemented programs that are consistent with the Innovation Agenda—for example, the Ontario Network of Entrepreneurs (formerly the Ontario Network of Excellence), support for venture capital and innovation financing, and investment in research programs.

Province Has Not Sufficiently Monitored Progress on the 2008 Innovation Agenda

As mentioned above, Ontario's 2008 Innovation Agenda had no timeframe for implementation and no established performance targets. Nevertheless, the province committed to developing a scorecard to measure and report on the progress of its investments in innovation and to allow comparisons with other jurisdictions.

In 2010, the Ministry of Research and Innovation developed a scorecard with 23 key indicators and measured the province's innovation performance based on data available at the time. The province ranked "weak" in two categories (commercialization and private investment), "satisfactory" in four areas (technology development and transfer, economic performance, linkages and support, and companies with research and development capacity), and "good" in three areas (public investment, research and education as it relates to innovation performance, and higher education and public research as it relates to innovation capacity). The Ministry selected nine jurisdictions, based on population size and gross domestic product, to compare against the same 23 indicators. They included three Canadian provinces (British Columbia, Alberta and Quebec), two American states (Massachusetts and Pennsylvania), and three

other countries (Israel, Australia and Sweden). In general, Ontario performed favourably compared to the other provinces, but tended to perform worse than the foreign jurisdictions.

In the absence of a subsequent assessment by the Ministry, we reviewed the innovation report card (How Canada Performs, A Report Card on Canada) issued by the Conference Board of Canada for 2015. Ontario was the highest rated provincial jurisdiction in innovation. However, the Conference Board of Canada gave Ontario its lowest rating (“D”) in the categories of business enterprise R&D investment, patents and labour productivity. The Conference Board’s rating would indicate a need for the province to improve in these areas.

The results of the Ministry’s 2010 assessment were not made public, and no subsequent assessment was performed. This means there has been no assessment done by the Ministry on whether provincial spending on research over the last five years has been effective.

Publicly Available Indicators Show Little Progress in Ontario’s Innovation

During our audit, we noted that the Ministry of Research and Innovation often referred to the Global Start-up Ecosystem Ranking to identify how provincial ecosystems ranked globally. The Global Start-up Ecosystem Ranking periodically ranks the world’s top start-up ecosystems for technology companies. Silicon Valley took first place and served as the baseline for comparison and measurement of all other ecosystems. In 2012, two Ontario cities were among the top 20 ecosystems in the world –Toronto was 8th and Waterloo was 16th. In 2015, both Toronto and Waterloo dropped in ranking to 17th and 24th place, respectively. Though the report did not specify the reason for the significant drop in ranking for Toronto and Waterloo, it should be cause for concern and requires further investigation by the province.

RECOMMENDATION 3

To assess progress on the province’s 2008 Innovation Agenda and provide comparisons between Ontario and its peer jurisdictions, the Ministry of Research and Innovation should conduct assessments periodically against the indicators in the scorecard and report the results publicly.

MINISTRY RESPONSE

The Ministry agrees to periodically assess the progress of the Ontario Innovation Agenda against indicators in the scorecard and report the results publicly.

The Ministry has been tracking performance measurements (such as patents, private-sector and public-sector research and development personnel, and research infrastructure investment) that capture different facets of the innovation system from publicly available sources, such as Statistics Canada, Thomson Reuters, the Canadian Foundation for Innovation and Tri-Council publications.

4.1.2 No Strategy but Some Action Taken by Ministry to Address Barriers to Commercialization

The Ministry has not developed a comprehensive commercialization strategy to eliminate the barriers to commercialization for intellectual property. In 2009, the Ministry of Research and Innovation and Industry Canada held a roundtable on commercialization barriers to university research. Participants included representatives of industry, university technology transfer offices and MaRS, the Toronto-based regional innovation centre. The group identified several barriers to commercialization and proposed actions to address some of them. Some of the more significant barriers to commercialization identified were:

- fragmented system of collaboration lacking any degree of co-ordination;

- lack of strategic focus on technologies and areas of science;
- weak system of knowledge management, with no means of understanding who is doing what and where;
- need for a stronger focus on partnerships and alliances in the realm of technology transfer;
- too much regulation and bureaucracy within the commercialization system;
- lack of adequate venture capital; and
- indicators such as patents, licences and disclosures are too narrow to measure the true outcomes of commercialization.

In the last several years, the Ministry of Research and Innovation has introduced many commercialization programs and, in conjunction with the Ministry of Finance, has created corporate tax credits and exemptions, which could address some of the barriers. However, it has not put a system in place to monitor its progress in addressing the commercialization barriers that were identified in 2009.

In 2008, the Ontario Tax Exemption for Commercialization was created to allow start-up companies in the field of information and communication technology that commercialize intellectual property developed at Canadian universities and colleges to get a refund on all corporate income tax and corporate minimum tax paid in the first 10 years of operations. However, this tax exemption, designed to promote commercialization, has been ineffective. Eligible companies have to apply for a certificate of eligibility issued by the Ministry of Research and Innovation. To date, only one certificate has been issued and no claims have been filed in regards to this tax exemption.

RECOMMENDATION 4

To address barriers to commercialization of intellectual property, the Ministry of Research and Innovation should consult again with stakeholders for a current review of barriers, develop a strategy and action plan with a timeline for

implementation, and monitor its progress on addressing those barriers.

MINISTRY RESPONSE

The Ministry will review the broad range of commercialization outcomes annually and will consult with members of the ecosystem (that is, members of ONE) to adjust and develop programs that respond to the current economic and ecosystem conditions.

The Ministry notes that commercialization programs were created to respond to barriers. For example, ONE was formed and structured to address concerns by:

- making it easier for entrepreneurs to start and grow their businesses in Ontario across all sectors of the economy;
- helping entrepreneurs access the programs and services they need;
- mobilizing knowledge and resources within colleges and universities to support business-led innovation and commercialization;
- co-ordinating provincial, federal, regional and private-sector programming and resources; and
- ensuring the roles of each organization do not overlap and are complementary to each other.

4.1.3 Selection of Research Projects

Applicant Selection Criteria for Research Funding Tied to Innovation Agenda

The 2008 Innovation Agenda highlighted four areas of the economy for initial strategic investment where Ontario already held a position of global importance: bio-economy and clean technologies, advanced health technologies, pharmaceutical research and manufacturing, as well as digital media and information and communications technologies. The Ministry has established a comprehensive selection process for awarding grants under the Research Excellence, Research Infrastructure

and Early Researcher Awards. For funding awarded under each program for the last five years, see **Appendix 1**. The Ministry's guidelines for these three key research grant programs, through which it funds university research, state that preference is given to the project proposals in the targeted areas identified in the 2008 Innovation Agenda. We reviewed all projects that have been awarded a research grant since the release of the 2008 Innovation Agenda and noted that at least three-quarters of the funding went to projects in the targeted sectors. Specifically, 76% of Early Researcher Awards, 79% of Research Infrastructure awards for large infrastructure, and 97% of Research Excellence awards went to projects proposing research in the targeted sectors.

Proposals for funding under the Research Excellence program are evaluated in four categories, one of which is the potential research impact. Research impact is based on the factors of commercialization (for example, market potential), economic benefits (for example, potential to increase Ontario's productivity and competitiveness) and societal benefits (for example, preserving the environment). Successful applicants require a score of at least 85% in this area. Proposals for funding under the Research Infrastructure program are evaluated, among other things, on the potential economic and societal impacts. Successful applicants require a score of at least 80% in these areas.

4.1.4 Ministry's Oversight on the Use of Funding

No Comparison of Final Research Outcomes with Potential Outcomes Noted at Proposal Stage

Although the Ministry of Research and Innovation has established a comprehensive selection process for awarding grants under the Research Excellence and Research Infrastructure programs, we confirmed with the Ministry that they do not compare actual results regarding impact with those noted in the grant applicants' original proposals at the time they applied for funding. This type of analysis

would be useful to determine whether universities are overstating the proposed benefits of their research in order to secure funding.

Improvements Needed to Measure the Impact of the Ministry's Investments in Research and Commercialization

The Ministry has developed performance indicators for its three key research grant programs for universities. **Figure 5** lists the performance indicators tracked by the Ministry and the combined results for all three research grant programs over the past five fiscal years. The Ministry uses these indicators to assess knowledge transfer; the quality of research; and the ability to enhance the knowledge, training and skill of research talent in the province. Information used to assess performance is obtained from annual progress reports submitted to the Ministry by grant recipients under the Research Infrastructure, Research Excellence and Early Researcher Awards programs. For the Research Infrastructure program, additional performance information is obtained from the Canada Foundation for Innovation, which is a co-sponsor and also collects performance data from grant recipients. The Ministry compiles this information by individual grant program and by all three grant programs combined.

The Ministry has also developed performance indicators for the commercialization activities it funds. Key performance indicators used to assess commercialization activities are listed in **Figure 6**. These include results for the last two fiscal years only because the Ontario Network of Entrepreneurs (ONE Program) was established in 2013 and the Ministry used different performance measures prior.

The performance results for research funding indicate that over the last five years (2009/10-2013/14), research grants have resulted in the creation of 172 start-up companies with 830 new employees. In addition, performance results indicate that over the last two years (2013/14-2014/15)

Figure 5: Ministry Performance Measures and Results for Major Research Grant Programs, 2009/10–2013/14

Source of data: Ministry of Research and Innovation

What Indicator is Measuring	#	Indicators ¹	2009/10	2010/11	2011/12	2012/13	2013/14	5-Yr Total/ Since Inception
Knowledge transfer	1	Invention disclosures	197	191	212	263	212	1,075
	2	Patent applications	117	161	193	219	152	842
	3	Patents granted	54	33	84	60	105	336
	4	Active Licences	41	49	74	78	98	340
	5	Spinoff/Start-up companies ²						172
	6	Employees in spinoff companies ²						830
Quality of research	7	Citations	29,017	32,650	85,195	60,424	48,376	255,662
	8	Publications	5,647	5,683	8,307	5,169	5,586	30,392
Ability to enhance research talent	9	Highly qualified people in university research projects	14,718	13,575	17,557	15,040	13,078	73,968
		Researcher	3,514	3,025	3,947	2,676	3,029	16,191
		Post-doctoral fellows	1,430	1,485	1,917	1,218	1,528	7,578
		PhD	2,672	2,146	3,269	3,121	2,524	13,732
		Master	2,899	3,043	3,423	1,819	2,172	13,356
		Undergraduate	3,059	2,421	3,540	3,958	2,272	15,250
		Other	1,144	1,455	1,461	2,249	1,553	7,862
	10	Degrees awarded to research team members ¹	1,104	1,328	1,695	1,283	1,350	6,760
		PhD	180	213	314	268	330	1,305
		Master	417	403	672	479	491	2,462
	Undergraduate	507	712	709	536	529	2,993	

1. Annual results are combined for all Ministry of Research and Innovation flagship research grant programs – Research Infrastructure, Research Excellence and Early Researcher Awards – except for indicator 10, which combines results for only the latter two.

2. Results are since inception of the Research Infrastructure, Research Excellence and Early Researcher Awards programs.

Ministry-funded commercialization activities led to the creation of 1,055 new companies, over 10,800 new jobs, and the retention of almost 16,500 jobs. However, the accuracy of these results is in question.

This and other concerns with the approach used by the Ministry to assess research and commercialization performance are as follows:

- Performance indicators for both research grant programs and commercialization programs are primarily activity-based measures and do not measure impact. Aside from tracking jobs created, jobs retained and start-up

companies, the Ministry does not have a mechanism for measuring the impact or benefits to Ontarians (also referred to as socio-economic benefits). Ontario is not alone in this respect. No other jurisdiction we researched in Canada and abroad had any publicly available socio-economic performance measures. In 2010, the Canada Foundation for Innovation, a federal funding agency, released a study identifying six types of socio-economic benefits (including, improvements in health care treatments, environmental benefits, and improved regulatory measures) against

Figure 6: Key Ministry Performance Measures and Results for Commercialization Activities, 2013/14 and 2014/15

Source of data: Ministry of Research and Innovation

Performance Indicators	2013/14	2014/15	Total
Economic			
New jobs created	6,482	4,350	10,832
Jobs retained	9,773	6,679	16,452
New firms created	811	244	1,055
New customers - Canadian	3,534,984	8,547,914	12,082,898
Sales revenue - Canada (\$ million)	230	211	441
Total sales revenue (\$ million)	463	406	869
Intellectual Property			
Published peer-reviewed publications	286	172	458
Patent applications submitted	999	804	1,803
Patent applications granted	290	301	591
Licenses established	32	35	67
Disclosures filed	185	65	250
Product Development			
Prototypes developed	2,365	3,052	5,417
Process improvements developed	1,395	1,390	2,785
Products launched/brought to market	1,667	2,588	4,255
Services launched/brought to market	1,497	2,270	3,767
Process improvements launched/brought to market	1,767	4,183	5,950

which research can be evaluated, but it too had not yet developed performance measures to capture their impact. From our discussions with representatives from the Canada Foundation for Innovation, the Ontario Council of University Research (a working group of the Ontario Council of Universities), and technology transfer staff at the universities we visited, this may be an area for all stakeholders to collectively develop useful measures to assess the impact and benefits to Ontarians. The 2008 Ontario Innovation Agenda recognized the need to measure and report on outcomes relating to how they impact the economy and quality of life. As well, the Higher Education Quality Council of Ontario, an independent advisory agency of the provincial government, issued a report in 2015 on Measuring the Economic Impact of Postsecondary Institutions, which highlighted the need for governments

and universities to measure outcomes from using research that affect society.

- The Ministry does not distinguish between funding for basic and applied research. Basic research, also called pure research, is scientific research that improves understanding of natural or other phenomena and advances fundamental knowledge. Applied research uses scientific theories and new ideas derived from basic research to develop new technology or techniques to intervene and alter natural phenomena or solve practical problems. So although basic research usually does not lead directly to inventions or discoveries with commercial potential, there is merit in basic research in that it creates the means to move forward on applied research. According to an academic research study from the University of Regina, basic and applied research go hand in hand whereas, without continuous

generation of basic knowledge, there will be no applied research and commercially viable innovation in the longer term. Basic research would therefore appear to not perform well when judged against knowledge transfer indicators (such as, number of invention disclosures, patents and licences). Therefore, performance indicators for basic research would have to differ from performance measures for applied research.

- Performance results for commercialization programs are incomplete and unreliable. Performance indicators for commercialization initiatives are based on client surveys conducted by service delivery agents (for example, the Ontario Centres of Excellence and MaRS). Clients receiving commercialization support are typically small and medium sized enterprises, including start-up companies. The Ministry acknowledged that there were limitations in the performance results because they were based on surveys. These limitations included low response rates and a change in the mix of respondents from one year to the next. For example, results in the 2014/15 annual report for the Business Acceleration program, administered by MaRS, were based on a survey response rate of 30%. In another example, according to the Ministry only 4% of the clients for one of the regional innovation centres responded to the 2014/15 survey. Similar problems were not found with recipients of research grant funding because funding is contingent on meeting reporting requirements. The Ministry informed us that service delivery agents were expected to have revised their contracts with clients by April 2016 in order to improve response rates.
- There is also a risk of duplicate information. The Ministry informed us that clients receiving commercialization support from more than one Ministry-funded commercialization program and who report to more than one service delivery agent could be submitting

the same performance results to all programs, hence overstating overall performance. There is also no assurance that information reported to commercialization programs on the number of inventions, patents and licences were not already included in performance measures for the research grant.

- Performance results on research funding and commercialization programs are not publicly reported. Performance results are used by the Ministry for internal purposes but are not transparent to the public, despite the recommendation of the Ontario Research and Innovation Council, the advisory to the Ministry, to be accountable and transparent. The need for regular public reporting has been reiterated by the government. In 2014, the Premier notified the Minister of Research and Innovation in writing that one of the Ministry's priorities was to promote openness and accountability by developing a website that highlights outcomes for all government investments in innovation, whether successful or not, including their impact on employment, growth and secondary innovations.

RECOMMENDATION 5

To ensure the Ministry of Research and Innovation (Ministry) is getting value for money for its investment in research and commercialization activities, the Ministry should:

- track what portion of research funding goes to basic vs. applied research, and develop appropriate indicators for each type of research;
- collaborate with stakeholders to collectively develop useful performance measures that assess the socio-economic benefits to Ontarians;
- increase the reliability of performance results by implementing measures to increase the response rate from clients receiving commercialization supports and

developing processes to eliminate duplicate reporting; and

- publicly report performance results on research funding and commercialization programs.

MINISTRY RESPONSE

The Ministry agrees to develop methods to track basic versus applied research. The Ministry notes that the delineation between basic and applied research is often not clear and is also dependent on the sector. The Ministry sees value in maintaining a standard and consistent reporting template in order to reflect the spectrum of indicators and to minimize the reporting burden.

The Ministry agrees to continue to work toward the development of socio-economic indicators.

As noted in the audit report, the Ministry has been working with its data collection partner to improve survey responses. The Ministry is aware of the challenges of collecting reliable and complete data for early stage companies and start-ups. Despite these challenges, the data gathered by the Ontario Network of Entrepreneurs (ONE) is held up as unique in the world in terms of the quantity of data collected. The Ministry agrees to continue to improve its data collection practices to address these challenges.

The Ministry agrees to publicly report on research and commercialization funding performance results.

4.2 Intellectual Property Rights

Intellectual property rights refer to the right to own intellectual property, the right to share in future income from the sale or licence of intellectual property, or the right to use intellectual property royalty-free. Research funding agreements and university policies typically specify the rights of inventors, universities and research sponsors.

Figure 7 summarizes policies on intellectual property ownership and profit sharing at the three universities visited.

4.2.1 The Province Does Not Typically Claim Rights to Intellectual Property Resulting from the Research It Funds

We reviewed a sample of contracts and funding agreements between provincial ministries, universities and the Ontario Centres of Excellence and found that none gave the province any ownership rights to intellectual property created with government funding.

The contracts were either silent on the issue or deferred to the institutions' policy on intellectual property ownership. In addition, except in one case, the contracts did not give the government the right to share in future profits from the sale or licence of intellectual property, or any right to use intellectual property royalty-free. The exception was the master research agreement between the Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the University of Guelph. The contract gives the Ministry a share in revenue and a perpetual non-exclusive right to use the intellectual property royalty-free for non-commercial internal purposes. Over the past five years OMAFRA received \$3.3 million in net licensing revenue, which represents a share of about 35%.

4.2.2 Intellectual Property Rights Vary Among University Research Sponsors

When comparing sponsors of university research, we found that the federal government and Ontario shared a similar lack of intellectual property rights. Industry partners also had similar ownership rights, except in cases where industry personnel were involved in conducting the research with university members and/or resources. But, unlike the government of Ontario, industry partners usually had the right to share in future income.

Figure 7: Intellectual Property Ownership and Profit-sharing Policies at Universities Visited

Prepared by the Office of the Auditor General of Ontario

University	Ownership Policy	Distribution-of-income Policy
University of Toronto	Owned jointly by the university and the inventor(s) at time of creation, unless these rights have been given up (in whole or in part) to a third party under a prior written agreement. When it comes time to commercialize, sole ownership is assigned to the university if the inventor(s) wants the university to assist and support. Sole ownership is assigned to inventor(s) if inventor(s) choose to commercialize through their own efforts.	<ul style="list-style-type: none"> • When university commercializes: 60% to inventor and 40% to university (to technology transfer office, department, or to a fund that supports future research). • When inventor commercializes: 75% to inventor and 25% to university (to department or to a fund that supports future research).
McMaster University	Owned by the university, unless rights have been given up to a third party under a prior written agreement. The inventor (academic researchers only) can get sole ownership if approved by the Intellectual-property Board.	<ul style="list-style-type: none"> • When university commercializes: 50% to universities and 50% to inventors or reinvested in future research (breakdown determined by Intellectual-property Board). • When inventor commercializes: 25% to universities.
University of Waterloo	Owned by the creator(s), unless rights have been ceded to a third party under a sponsorship agreement.	<ul style="list-style-type: none"> • When university commercializes: Generally, 75% to inventor and 25% to university (of which half stays with corporate level and half flows back to originating faculty). • When inventor commercializes: 100% to inventor.

Universities also had rights to intellectual property that the Ontario government did not have. Two of the universities we visited had some level of ownership (100% if they became the commercialization agent), and shared in future profits whether or not the university became the commercialization agent. The third university had no ownership rights and shared in future profits only if it was responsible for commercialization. Unlike the province, all three universities had the right to use intellectual property royalty-free for non-commercial purposes (for instance, research, teaching and administrative), even in cases where the intellectual property was owned entirely by the inventor and the university was not involved in commercialization.

4.2.3 Other Government Jurisdictions Typically Do Not Claim Intellectual Property Rights

By comparing other Canadian and international jurisdictions that fund university research, we found that practices regarding ownership and income sharing were similar to those in Ontario. They typically do not maintain ownership of any resulting intellectual property or have the right to any future income. Regarding the right to use intellectual property royalty-free for non-commercial purposes, all but one international jurisdiction had a similar practice to Ontario. The U.S. federal government, under the 1980 *Bayh-Dole Act* which served to transfer intellectual property ownership from the federal government to institutions and inventors, still reserved the right to a royalty-free licence for its own use for inventions created with federal funding.

The Ministry informed us that Ontario's rationale of not having intellectual property rights on provincially funded research projects, including license income and/or royalty-free use, is based on the view that "government ownership of IP impedes the speed of commercialization." The Ministry describes the current approach as "consistent with best jurisdictional practices, federal policy and academic/industry preference." In addition, government ownership of intellectual property was viewed as not being cost effective since there appears to be a presumption that resources required to manage intellectual property rights may be more costly than the income generated.

Although there may be costs involved with owning intellectual property and managing licencing agreements, royalty-free use of intellectual property has the potential to provide future cost savings to the government. Also, intellectual property rights should not be viewed as an impediment to commercialization without further detailed analysis of the impact and potential value to Ontario.

RECOMMENDATION 6

The province should re-visit and assess the pros and cons of including provisions in selective research funding agreements that would allow it to share in future income from the sale or licence of resulting intellectual property, and/or to have the non-exclusive right to use the intellectual property royalty-free for non-commercial internal purposes, where there may be value to do so.

MINISTRY RESPONSE

The Ministry agrees to assess the pros and cons of adopting this approach.

4.3 University Oversight of Research and Intellectual Property

4.3.1 Proper Controls in place to Manage Research Funding according to the reviews by the Canada Foundation for Innovation

Every three or four years the Canada Foundation for Innovation, which provides universities with funding to build research infrastructure, conducts reviews at universities to assess the controls in place to properly manage the funding provided. Specifically, the assessment includes review of controls and procedures to ensure the timely implementation of projects, mitigation of the risk of cost escalation, the use of funds, the university's actions to sustain infrastructure over its useful life, and the optimal management of the portfolio of funded projects. The universities confirmed that processes and practices evaluated by the Canada Foundation for Innovation are also used to manage research funding provided by the province. As a result, to avoid duplication, the Ministry of Research and Innovation relies on the results of the reviews conducted by the Canada Foundation for Innovation.

For the universities visited, all three universities had reviews conducted in the last two years, but only two universities had recent reports. These two universities received satisfactory ratings in all the key evaluation criteria that were rated. The third university was expecting to receive the report of its results by December 2015.

4.3.2 Performance Measures

The Association of University Technology Managers (AUTM) surveys universities annually on a number of performance measures. This allows universities to compare commercialization results across Canada. **Figure 8** compares key indicators for the universities visited and for other Canadian and U.S. universities for the 2013/14 fiscal year. The universities we visited typically did not have any

Figure 8: Key Commercialization Indicators and Results for Technology Transfer Offices, for Fiscal Year Ending 2014

Source of data: FY2014 Licensing Activity Surveys by the Association of University Technology Managers

	Ontario Universities Visited			Canadian Universities for Comparison			U.S. Universities for Comparison		
	Universities ¹			Universities ²			Universities ³		
	1	2	3	1	2	3	1	2	3
Total Research Expenditures ⁴ (\$ million)	424	275	181	564	411	463	812	1,605	887
Patent applications filed	78	83	32	119	105	81	543	555	590
US Patents issued	17	2	5	32	23	22	89	94	187
Invention disclosures received	147	71	29	128	128	90	452	453	481
Disclosures included in licences executed	62	24	4	27	44	39	n/a	139	106
Start-up companies formed	20	3	12	3	6	5	10	13	23
Active licences at Y/E	203	183	298	328	239	239	699	713	1,400
Licences generating income each year	65	154	7	83	55	32	270	376	655
Licences generating income over \$1M during the year	3	0	0	2	1	0	3	2	6
Total licence income in year ⁴ (\$ 000)	34,664 ⁵	2,284	320	5,897	4,819	557	17,332	16,527	108,605

1. 1 is the University of Toronto; 2 is McMaster University; and 3 is the University of Waterloo (only university visited without a medical school).

2. Universities in large Canadian provinces.

3. Universities in the United States with significant research activity.

4. In Canadian or U.S. dollars as applicable.

5. This is an anomaly that includes a \$27 million payment from one technology that achieved a significant milestone in 2014 with the initiation of a phase 3 trial. The total licence income averaged \$4.6 million over the previous 5-year period.

n/a – No information was included in the data set. The prior year figure was 106.

performance measures for the technology transfer offices beyond what they reported in the AUTM survey.

Universities Do Not Measure Socio-economic Impact of Research and Innovation

As is the case with the Ministry of Research and Innovation, universities also use activity-based measures that do not comprehensively capture the socio-economic impact of their research activities and commercialization efforts. In addition, some of the existing measures are not useful; for example, it would be more useful to know how many start-up companies have been in business for at least five years, in addition to how many were created in the year. This issue of assessing economic and social

benefits to Ontarians was discussed in more detail earlier in **Section 4.1.4**.

Intellectual Property Generating Little Revenue for Universities

None of the technology transfer offices highlighted revenue generation as a key driver. They told us their goals were primarily to help build successful partnerships among industry, business, government and the university research community, and to turn ideas into commercially viable products and services, companies and jobs for societal and economic benefit.

Similar to universities in other jurisdictions, the three technology transfer offices we visited generally operated at a deficit. As shown in **Figure 9**, from 2011/12 to 2013/14, two offices generated

Figure 9: Revenue Collected From Intellectual Property Compared to Expenses of the Technology Transfer Office, for Each University Visited

Source of data: Technology Transfer Offices for the three universities visited.

	2011/12 (\$ 000)	2012/13 (\$ 000)	2013/14 (\$ 000)
University of Toronto			
Revenue before distribution	6,102	3,005	34,664
Revenue to University*	1,192	1,489	9,469
Expenses of the Technology Transfer Office	2,965	2,767	2,260
Net income/loss to University	(1,773)	(1,278)	7,209
McMaster University			
Revenue before distribution	2,120	2,370	2,284
Revenue to University*	1,014	1,119	1,110
Expenses of the Technology Transfer Office	1,903	1,780	2,179
Net income/loss to University	(889)	(661)	(1,069)
University of Waterloo			
Revenue before distribution	706	559	320
Revenue to University*	n/a	n/a	n/a
Expenses of the Technology Transfer Office	1,371	1,438	1,601
Net income/loss to University	n/a	n/a	n/a

* Revenue to University is any revenue retained by any office within the university e.g. technology transfer office, research office, faculties, etc.

n/a – data not available

less money from their intellectual property holdings than it cost to operate their office in all three years. The other one brought in less money from intellectual property than it cost to operate its office for two of the three years. According to a 2009 study, more than half of the university technology transfer offices surveyed in the U.S. brought in less money than the cost of operating the program. Furthermore, only 16% of U.S. university technology transfer offices were self-sustaining and generated enough revenue, after distributions to inventors, to cover operation costs.

A number of studies outline the reasons it is difficult for technology transfer offices to cover their operating costs with revenue accrued to the university from inventions. An expert federal panel reported in 2011 in *Review of Federal Support to Research and Development* that it was difficult for innovative firms with high growth potential (that is, start-ups) to get the capital needed to achieve

commercial viability. A 2014 academic study also highlighted the fact that the amount of licensing income generated is not under the direct control of the technology transfer offices due to the effectiveness of the technology, the market, and the licensing company's efforts.

In order to gain insight into how effective technology transfer offices were in commercializing intellectual property at the three universities visited, we gathered data on (1) the overall average income received each year from income-generating licences (using data submitted to the Association of University Technology Managers for the five-year period from 2009/10 to 2013/14) and (2) the overall average percentage of income-generating licences making more than \$1 million annually (using the same data). We noted the following:

- For (1), we compared the annual average income from the three universities visited to that for all reporting Canadian universities

combined and that for all reporting U.S. universities combined. The nation-wide averages were \$130,000 for all reporting U.S. universities combined and \$61,000 for all reporting Canadian universities combined. The three universities we visited had averages of \$13,000, \$59,000 and \$160,000.

- For (2), we compared the annual average percentages from the three universities visited to that for all reporting Canadian universities combined and that for all U.S. universities combined. The nation-wide averages were 1.07% for all reporting U.S. universities combined and 0.81% for all Canadian universities combined. Only one of the universities we visited reported holding licences that made over \$1 million annually (representing 2.3% of its total income-generating licences). One of the other two universities told us that it had a single technology that generated over a million dollars annually but that this was generated through several non-exclusive licensing agreements and therefore would not be captured by the data. The other university told us that it focused its efforts on the creation of start-up companies and that the university defers collecting revenue until the start-ups become profitable.

Better Public Reporting of Performance Required

At each of the universities visited, we reviewed the performance information reported by the technology transfer offices to the Vice President of Research, and noted that only one university's technology transfer office reported on its performance measures regularly.

Only two universities we visited issued annual research reports that were available publicly. In both cases, these reports included information on research funding, recognition awards and citations. Only one university reported against some perform-

ance measures for commercialization efforts carried out by the technology transfer office.

Significant Research Discoveries at the Three Universities Visited

We asked the universities to tell us some of their most significant research discoveries to date.

Figure 10 summarizes the discoveries or inventions identified.

RECOMMENDATION 7

In conjunction with government sponsors, universities should develop socio-economic performance measures to better communicate the outcomes of their research and commercialization efforts.

SUMMARY OF UNIVERSITIES' RESPONSES

The universities agree that socio-economic performance measures would be useful for assessing outcomes of research and commercialization efforts, but all noted that collecting such data would be challenging given the breadth and volume of research activity occurring at universities.

One university stated that since funding agencies typically drive what is required for research reporting purposes, government agencies should collectively take a leadership role in establishing harmonized reporting requirements. This would allow for the measurement and comparison of the socio-economic impact of government-sponsored research.

Two universities indicated that they would explore collaborating with government sponsors to identify appropriate socio-economic performance measures. Another university indicated that it would consider systematic approaches to collect socio-economic measures.

Figure 10: Significant Discoveries and Inventions as Identified by the Universities Visited

Source of data: Universities visited

Discovery/ Invention	University of Toronto	McMaster University	University of Waterloo
1	Insulin (1921) – discovery and first commercial production.	IBDQ (1997) – quality of life questionnaire for patients suffering from intestinal bowel disease; used by pharma/biotech companies doing clinical trials to treat diseases.	FORTRAN Compilers (1960s) – WatFOR and WATFIV compilers revolutionized computing.
2	Pablum (1930) – invention of first processed baby cereal.	Early Development Instrument (2007) – electronic tool used to assess and measure child development.	Text Search Engine (1988) – Oxford English Dictionary searchable text database software developed which lead to the creation of Open Text Corporation.
3	Anti-blackout suit (1942) – invention ultimately becomes space suit.	Respiratory Virus Panel technology (2006) – biomarker technology tool incorporated into a diagnostic device for the detection of respiratory viruses.	Permeable Reactive Barriers (1990s) – groundwater treatment technology used globally to clean up industrial contaminated sites.
4	Electron microscope (1938) – world’s first electron microscope developed.	OSCAR (2005) – electronic medical record software widely adopted in Canada and around the world.	Quantum Processing (2007) – current world record for a 12-qubit quantum information processor.
5	Artificial cardiac pacemaker (1951) – first artificial cardiac pacemaker pioneered.	Multivariate analytics (2002) – patented process to analyze large batches of data to correlate with process improvements or product quality; used to monitor and optimize manufacturing systems for the chemical, food and energy industries.	Structural Similarity (SSIM) index (2004-14) – Engineering Emmy® Award (2014) winning software that accurately predicts how humans perceive image/video quality.

RECOMMENDATION 8

Universities should review their research reporting requirements on performance measures, and identify opportunities to report more detailed information in the annual research report and in management reports going to senior management.

SUMMARY OF UNIVERSITIES' RESPONSES

The universities agreed with this recommendation. Two universities stated that they will continue to review indicators for relevance and update them as necessary. The third university indicated it will undertake a review of its research reporting requirements in consultation with key stakeholders and consider what

information should be reported in an annual research report and in management reports.

4.4 Commercialization Activity at Universities**4.4.1 Disclosure of Inventions to the University**

A disclosure is a confidential written notification to a university's technology transfer office that an invention has been created using university resources by faculty, employees, students or persons from the private sector working in collaboration with the university. It is the first official acknowledgement to the university of the creation of intellectual property.

Policies at each of the universities visited require all staff and students to disclose intellectual

property discovered to their university's technology transfer office. Each university has a standard invention disclosure form to be completed by inventors and submitted to the university's technology transfer office. This disclosure form usually includes a description of the invention, the sources of funding that supported its creation, the inventors and contributors behind the invention (whether internal or external) and whether details of the intellectual property have been disclosed publicly.

Figure 11 shows the number of inventions disclosed from 2009/10 to 2013/14 to the technology transfer offices at the universities visited. We compared total research expenditures with the number of invention disclosures for the same year and noted that, over the five-year period, two universities spent on average almost \$5 million research dollars for every invention disclosure generated, and one spent \$2.6 million. In comparison, using AUTM data for the 5-year period 2008/09-2012/13, we noted that the average spent by all Canadian and U.S. universities to generate a disclosure was \$3.3 million and \$2.7 million respectively. Two universities we visited require disclosure even when the inventor does not intend to commercialize. The other university, with the lowest number of invention disclosures and the highest research spending per disclosure, did not take any ownership rights and did not require inventors to disclose their inventions if they had no intention of having them

commercialized by the university's technology transfer office. A few issues regarding the invention disclosure process are described in the following subsections.

Universities Could do More to Ensure All Inventions are Disclosed

The onus is on researchers to disclose their discoveries to the technology transfer office. The universities visited are, thus, unable to ensure that all intellectual property is being disclosed. Each university posts disclosure policies regarding intellectual property on its website. In addition, the technology transfer offices make presentations to interested staff and students to inform them about their services and policies related to intellectual property. We reviewed copies of the presentation material and noted that presentations made by the technology transfer offices did not make it clear that the universities require researchers to disclose any inventions.

At the three universities we visited, the number of invention disclosures may be one of the factors considered during annual performance reviews of faculty members and could affect future promotions, merit increases and tenure. However, during our audit, we noted that faculty departments had to obtain the information required for annual performance reviews, such as the number of research discoveries or invention disclosures directly from

Figure 11: Number of Invention Disclosures by Universities Visited and Research Dollars Spent for Every Invention Disclosed, 2009/10-2013/14

Source of data: Universities visited and the Association of University Technology Managers

	Number of Invention Disclosures					5-Year Averages		
	2009/10	2010/11	2011/12	2012/13	2013/14	# of Invention Disclosures	Total	Research
							Research Spending (\$ 000)	Spending Per Invention Disclosure (\$ 000)
University of Toronto	136	192	158	166	147	160	422,807	2,646
McMaster University	54	68	77	65	71	67	291,408	4,349
University of Waterloo	45	43	26	47	29	38	186,268	4,902

the faculty member, rather than independently through the technology transfer office. We confirmed with technology transfer office staff that information on discoveries reported by faculty members for performance review purposes were not shared or reconciled with the invention disclosures made to the technology transfer office. If faculty departments used only disclosures made to the technology transfer office for performance review purposes, there may be more incentive for faculty members to disclose their inventions to the office.

We also noted that the technology transfer offices did not monitor status reports prepared periodically by research grant recipients, sometimes with the help of the university research office, and submitted to their funders to help ensure completeness of invention disclosures. As previously mentioned, the Ministry of Research and Innovation requires research grant recipients to submit a progress report to summarize the project status and highlight any achievements. Similar reporting requirements also exist in funding agreements with the federal government and private industry. Monitoring these reports can help identify any undisclosed inventions.

Researchers Need Guidance on Use of University Resources to Create Intellectual Property

There is a risk that discoveries using significant university resources are undisclosed at two universities we visited that require disclosure even when the inventor does not intend to commercialize. This could lead to a loss in revenue for the university, or the new technology could be taken out of province and commercialized elsewhere. When no significant university resources are used, inventors inherently own their own intellectual property without any obligation to report, disclose or share future revenues with the university. It is up to the researchers' respective faculties to confirm that no significant university resources were used. However, the technology transfer offices do not provide any guidelines outlining the nature and

extent of work that faculties need to do to verify that university resources were not used. We found that both technology transfer offices did not retain documentation of the work done by faculties to confirm whether significant university resources were used.

RECOMMENDATION 9

To ensure that all intellectual property created with university resources is disclosed, universities should:

- develop guidelines to help faculties assess university resources in the creation of intellectual property and to require such assessments be documented;
- clearly communicate invention disclosure requirements during technology transfer office presentations to staff and students;
- require all faculties to use only disclosures made directly to the technology transfer office for performance review purposes; and
- use research grant status reports sent to research funders to anticipate and track completeness of disclosures.

SUMMARY OF UNIVERSITIES' RESPONSES

The universities were generally in agreement with this recommendation.

For the two universities we visited that require disclosure even when the inventor does not intend to commercialize, one indicated that it will consider developing formal guidelines to help assess the university resources used in the creation of intellectual property. The other did not provide an action plan because, under the university's policy, the creator is the owner of the intellectual property.

All universities agreed with clearly communicating invention disclosure requirements through presentations and on their websites.

With respect to the recommendation to require all faculties to use only disclosures made

directly to the technology transfer office for performance review purposes, one university stated that it would consider the feasibility of such a process. Another university said it was in the process of ensuring sufficient reporting of disclosure information to faculties. The third said it expects this recommended action to be addressed by the upcoming implementation of online reporting for invention disclosures.

With respect to the recommendation to use research grant status reports to track disclosures, two universities said they would consider it. The other university did not feel the need to track potential disclosures since, under its intellectual property policy, the university did not have any rights to ownership.

4.4.2 Assessments of Invention Disclosures

Once a discovery or invention is disclosed to the technology transfer office, the first step in the technology transfer process is to assess whether the disclosure warrants the investment of additional resources for further development and commercialization.

The technology transfer offices we visited assessed inventions against four factors:

- technical merits of invention;
- inventors' level of commitment to support the invention through the commercialization process;
- marketability (considering barriers to entry, time to market, potential growth, industry trends, and customer base); and
- patentability, or determining whether prior patent filings exist for the same invention.

The assessment generally begins when transfer office staff meet with inventors to get a better understanding of the invention's technical merits and gauge their level of commitment to supporting the invention through the commercialization process. Technology transfer office staff told us that without inventor support or a solid technological

basis for the invention, it is challenging to proceed with commercialization; the offices are often looking for private industry to license an invention, so its technology must be sound. To obtain a patent, the technology transfer office must go through a process of proving to a patent office why the invention warrants one. Because inventors are often the greatest source of information and technological expertise regarding the invention, their involvement is required to increase the likelihood of obtaining a patent. The assessment process also involves reviewing the technical aspects of the disclosure contained in the disclosure form, conducting patent searches (if applicable), and analyzing the market and competitive technologies to assess the invention's commercialization potential and likelihood of success, which will guide the commercialization strategy.

Overall we noted that transfer office staff who assessed the commercialization potential of invention disclosures were qualified to make the assessments. We found that many of the staff who performed the assessments held master's degrees and PhDs, and were generally assigned to assess disclosures in the fields most closely related to their educational background and experience.

Our issues with the assessment of invention disclosures are noted below.

Assessment of Commercial Potential of Disclosures is Subjective

Technology transfer office staff explained to us that more specific criteria for the assessment of commercial potential do not exist because of the unique nature of each disclosure. As such, the assessment process is subjective. Our review of assessment practices in other jurisdictions did not identify additional or more specific assessment criteria. This makes the assessment process subjective. Given the subjectivity involved, it may be prudent for assessments to undergo a second level of review by another technology transfer staff member, particularly for the more complex disclosures. However, a

formal second-level review process was not in place at the universities we visited. Technology transfer offices told us that staff meet regularly to discuss issues relating to disclosures and to seek input from co-workers, but this did not constitute a formal second-level review prior to acceptance.

Technology Transfer Offices Do Not Formally Track How Long Assessments Take

Timely assessment of invention disclosures is important for patent protection because delays in filing patents create a risk that others could file for patent protection first. We noted that each of the technology transfer offices we visited had established a different target for completing initial assessments: four weeks, 45 days, and three months. However, none formally tracked compliance with their targets.

Commercialization Decisions Lack Documentation

We found that documentation to support the decision to accept a disclosure for commercialization varies according to technology transfer office. One office typically used an external organization to assess just over half of the disclosures it received. At this external office, a formal assessment form was used to record initial patentability and marketability assessments, but this document was missing from the files in 30% of the projects we reviewed. The other two offices did not formally document their assessment decisions. We were told that they informed inventors of their decisions either verbally or via email.

Only one technology transfer office had a policy requiring an annual review of decisions to determine whether to continue or terminate efforts to protect and commercialize inventions. However, we could not confirm that any review took place because none of the reviews were documented. The other two offices did not have a formal policy for project re-evaluation. All three offices said disclosures are constantly evaluated during the

commercialization process as staff work to negotiate and secure licensing deals, determine whether to pursue and file patent protection, arrange additional development funding, and communicate with inventors. We reviewed the files but were unable to confirm whether this type of ongoing evaluation actually occurred because of limitations in the available documentation, as described below.

RECOMMENDATION 10

In the absence of objective criteria to assess the commercial potential of disclosures, university technology transfer offices should develop a formal process to discuss and challenge decisions on commercial potential, including assessments undergoing a second level of review.

SUMMARY OF UNIVERSITIES' RESPONSES

One university indicated that having better processes to discuss and challenge decisions is of value. This university stated it will formalize its process of discussing and challenging decisions, and will improve documentation. Another university stated that it will consider a formal secondary review of all disclosures with respect to staffing, workload and timeline considerations. The third university stated it would continue with its current practice of taking up to one year engaging market participants to determine whether there is a market for the technology.

RECOMMENDATION 11

To help ensure commercialization assessments are completed within a reasonable timeframe to avoid delays in patent filings, university technology transfer offices should:

- establish time frames to complete assessments based on technology type or complexity of invention; and
- formally track and review how long it takes to complete assessments, and address any delays identified.

SUMMARY OF UNIVERSITIES' RESPONSES

All universities generally supported the recommendation and have implemented internal time frames for the completion of commercialization assessments. Two indicated they will establish formal tracking mechanisms to determine compliance with established timelines.

Two universities indicated there may be reasons to delay a patent filing. These can include securing further research data to support broader and more defensible claims, and prudently managing the timeline to patent to defer cost escalation.

4.4.3 Protection of Intellectual Property

The objective of protecting intellectual property is to encourage the creation of valuable ideas and prevent them from being stolen. Protection comes in different forms depending on the nature of the intellectual property. Copyrights are used to protect original literary, musical, dramatic or artistic works; trademarks are used to protect a logo, word, slogan, symbol or design that distinguishes a product or service; and patents are used to protect inventions and new technologies such as machines, devices, materials, processes, and improvements of any of these. A patent provides inventors and those who hold rights to inventions the exclusive right, for a limited time, to prevent anyone else from making, using or selling the invention. Most jurisdictions worldwide, including Canada, operate on a first-to-file patent system in which the first inventor to file a patent application has priority over others wishing to file for the same invention.

Only after a patent has expired may anyone other than the patent holder freely make, use or sell the invention. In Canada, a patent is granted for a maximum period of 20 years after the application date. Rights offered by a Canadian patent extend throughout Canada, but not to other countries. Similarly, foreign patents do not protect an inven-

tion in Canada. Therefore, inventors would need to apply for patent rights in each country separately.

Patent costs are borne initially by the technology transfer office and later by a private sector partner who buys or licenses the technology for commercial purposes. Patenting costs can be significant over the 20-year-life of a patent. Fees paid to the patent office alone over those 20 years could amount to \$5,600 for a regular Canadian patent and about \$13,000 for a regular U.S. patent. Legal costs incurred to obtain a patent generally range in the tens of thousands of dollars but can go higher depending on the complexity of the situation and whether one is applying for a patent in more than one jurisdiction.

A U.S. patent is usually sought for most inventions because the United States is a larger market for companies that are willing to license new technologies and for users of inventions, and because it offers a provisional patent for \$150 that can be converted into a Canadian patent filing. A provisional patent provides some patent protection by establishing a patent filing date, giving the inventor first right to obtain the patent, and giving the technology transfer office 12 months to initiate formal patent filings in jurisdictions of its choosing. During this time, the technology transfer office works on securing an industry partner and performing market validation to determine whether continued efforts are justified.

Our issues in this area were as follows:

- The time it takes to file the first patent varies among universities and may in some cases be too long. Delays in patent filings increase the risk of not being able to obtain a patent since a previous patent for the same technology may already exist. We reviewed the time taken to file an initial patent protection of any type, i.e. U.S. provisional patent, patent corporation treaty, or formal patent in any country, for a sample of disclosures generally made between 2011/12 and 2013/14 at the universities visited, from the date the disclosure was received. The average time ranged

from 80-188 days for a U.S. provisional patent and 25-211 days for all other types of patent filings, as shown in **Figure 12**.

- Some inventions were publicized before any patent protection was in place. Publicly discussing an invention before it is patented can jeopardize one's ability to seek patent protection. Based on our review of invention disclosure forms submitted at each university visited, from 2011/12 to 2013/14, 24%–40% of inventors indicated that they had publicly disseminated information about their invention before disclosing it to the technology transfer office. Agreements between faculty and universities as well as research funding agreements for select grant programs we reviewed at the universities visited did not contain restrictions on publicly disseminating research results before considering the existence of intellectual property and arranging for its protection. Furthermore, while some faculty may become aware of these requirements through optional information sessions delivered by technology transfer offices, only one university we visited had a formal policy on its website warning about public disclosure of discoveries.

RECOMMENDATION 12

To help ensure intellectual property is properly protected, universities and/or their technology transfer offices, as applicable, should:

- ensure contracts with faculty associations and researchers include provisions to make them aware of the importance of not disclosing inventions prior to filing for patent protection; and
- file for patent protection as early as possible, where appropriate, to minimize the risk of others filing first and precluding them from obtaining a patent.

SUMMARY OF UNIVERSITIES' RESPONSES

Two universities were of the opinion that existing policies for invention disclosures were adequate. The third university indicated that the creation of intellectual property and its commercialization were not a core mandate of the university, and therefore provisions on the importance of not disclosing inventions prior to filing should not be included in faculty association agreements.

One university stated that academic freedom to publish without constraint is a core university principle. Another university stated that faculty members are best positioned to make decisions on when to publish their results. It further stated that the primary mandate is to ensure the appropriate and timely dissemination of research that has been largely publicly funded.

Figure 12: Time Taken to First Apply for a Provisional or Formal Patent,¹ for a Sample of Disclosures Received Between 2011/12 and 2013/14

Source of data: Prepared by the Office of the Auditor General of Ontario from university data

	U.S. Provisional Patent (days)		Formal Patent in Any Jurisdiction (days)	
	Average	Longest	Average	Longest
University of Toronto	188	647	211	290
McMaster University	108	385	n/a ²	n/a ²
University of Waterloo	84	279	25	49

1. A formal patent application includes any application other than a U.S. provisional patent application.

2. For the sample of disclosures selected for testing, all first filings were U.S. provisional patents.

AUDITOR GENERAL RESPONSE

We continue to believe that the implementation of our recommended actions would be prudent.

4.4.4 Documentation of Commercialization Processes Falls Short / Commercialization efforts lack standard documentation

None of the technology transfer offices had a proper case-management system to document key decisions or actions taken on each invention disclosed to them. Failing to document the full nature of commercialization efforts in a consistent and standardized manner poses the risk that transferring knowledge among personnel will be inefficient and unreliable, particularly when there is a change in management or staff turnover. Outgoing staff may not be available to share knowledge, and specific details could be lost or forgotten with the departure of staff who spent years working on individual projects.

We reviewed a sample of disclosures accepted for commercialization at each technology transfer office between the 2008/09 and the 2014/15 fiscal years and found a number of factors relating to documentation that made it difficult to assess the sufficiency and scope of commercialization efforts:

- Key decisions and actions were not documented on a summary sheet.
- There was no requirement for technology transfer office staff to document any of the wide variety of commercialization activities, such as holding meetings or having phone discussions with potential licensees.
- There was no checklist indicating the full suite of commercialization activities to be undertaken.
- Technology transfer offices found it challenging to gather all relevant data relating to each disclosure that would show the extent of commercialization efforts. For example, their information systems captured hundreds of emails relating to the management of any

given invention; it was difficult for staff to review and single out only those that would provide a cohesive picture of their efforts. As a result, without the presence of commercialization managers to explain what actions they had taken to date on the disclosures assigned to them, the electronic files alone could not depict the full scope of commercialization efforts related to each disclosure.

We also inquired into the nature of oversight performed by technology transfer office management. There was no evidence that management used formal reports to assess efforts to facilitate commercialization. Rather, management told us they held informal meetings with staff to discuss problems or issues in the commercialization process, but these were not documented.

RECOMMENDATION 13

To permit efficient management review of commercialization decisions and efforts and to help facilitate knowledge transfer among personnel in case of staff turnover, universities should:

- develop case management documentation guidelines; and
- ensure that commercialization decisions and actions are clearly and consistently documented in accordance with the guidelines to be developed.

SUMMARY OF UNIVERSITIES' RESPONSES

All universities were in agreement with this recommendation.

4.4.5 Managing Intellectual Property Projects

No Formal Guidelines to Manage Costs Incurred to Commercialize Intellectual Property

None of the offices we visited have written policies or guidelines on managing costs. This increases the risk that commercialization efforts and costs

could be incurred on projects with limited potential. Technology transfer office expenditures are primarily salaries and benefits (60% to 70%), patent costs and legal costs (20% to 30%), and other expenditures (5% to 10%). One technology transfer office informed us that it has an informal guideline of generally not exceeding \$50,000 to \$60,000 in patent costs without a potential licensee being identified and engaged in discussions. We reviewed the costs incurred for all disclosures made to this office since 2006 and identified nine disclosures that had incurred costs in excess of \$60,000 without generating any income. Of these, five were still not licensed or optioned at the time of our audit. The other two offices did not have a policy on the maximum costs permitted by project and were not tracking costs accumulated per project.

Improvements Needed in Revenue Collection

We identified a number of concerns with regard to revenue collection at the technology transfer offices we visited, including issues with timely billing and collection of amounts owing, and lack of verification of the amounts paid. For the three universities visited, we identified all revenue-generating agreements in place with regards to intellectual property, and tested a sample of revenue received in the past three years. Specifically, we noted the following:

- Some amounts owing were not collected on a timely basis. Overall, 69% of licensing fees due were billed late, and 62% of licensing fees and 23% of royalties were received late. These were typically one-time licence fees or annual minimum payments due on predetermined dates. Technology transfer office staff told us there were various reasons for the delays. Sometimes companies were having internal difficulties. In other cases the problem rested with the universities. For example, two universities informed us they did not have a system in place to alert them when payments were due. One university has since corrected

the problem by implementing a receivable reminder system.

- At one university, we saw a case where a 75,000-euro payment due June 15, 2010 was not billed until November 2011. The payment was collected in March 2012. In another example, the same university, as a shareholder in a start-up company, did not receive a \$275,000 dividend that was declared in October 2011 until November 2013. The university did not provide us with a reason.
- Two universities did not always receive adequate documentation to support the royalties remitted to them. Contracts for royalty fees normally required the licensee to submit reports, often certified by an officer of the company, to support the sales generated or the quantity of items sold in that period. Of the royalty fees we tested, supporting documentation to verify the amount remitted was not provided in 13% of the cases sampled at one university and in 43% of the cases sampled at another. At the third university, revenue reports were submitted for all cases sampled, but were not always certified by an officer of the company as required. Where supporting documents were received, we generally found little or no evidence of review.
- Although many agreements allowed technology transfer offices to request an audit when royalties depended on the amount of sales generated or units sold, in all of the tested cases the offices did not request audits. The universities told us that this was usually because the amounts received were too small to justify the cost of an audit. However, none of the universities visited had criteria on when to ask for an audit report. According to the contracts we reviewed, the technology transfer office would typically bear the cost of the audits unless they showed an error over a certain percentage to the detriment of the university.

- Overall, approximately 30% of licensing agreements included a provision for interest charges on late fees. However, for the sample tested, interest charges were never applied.

RECOMMENDATION 14

To manage costs incurred in the effort to commercialize intellectual property, university technology transfer offices should implement formal policies and guidelines regarding cost management, and track costs incurred by type (e.g. legal costs, patent fees, and marketing) for each disclosure.

SUMMARY OF UNIVERSITIES' RESPONSES

All three universities were generally in agreement with the recommendation. One university said it would consider the need for formal policies and guidelines regarding cost management, and another university said it will develop general guidelines to ensure appropriate cost-management practices.

RECOMMENDATION 15

To help ensure the timely and accurate collection of revenue owing, all universities should:

- ensure they have an accurate and up-to-date tracking payment schedule that includes due dates, so that universities can bill one-time payments in advance and remind licensees to submit royalty payments on time;
- obtain sales and revenue reports from licensees to support the amount of royalties remitted;
- develop criteria to help assess when it is worthwhile to ask for an audit report (for example, when royalty payments are dependent on sales generated); and
- enforce the interest penalties stipulated in contracts to encourage licensees to submit revenue payments on time.

SUMMARY OF UNIVERSITIES' RESPONSES

All universities were in agreement with this recommendation. The two universities to which most of the findings in this section related stated that they are addressing the concerns.

Appendix 1—Ministry of Research and Innovation Funding by Program, 2010/11–2014/15

Prepared by the Office of the Auditor General of Ontario using Public Accounts and Ministry of Research and Innovation program information

	Applicable to University Research	2010/11 (\$ 000)	2011/12 (\$ 000)	2012/13 (\$ 000)	2013/14 (\$ 000)	2014/15 (\$ 000)	Total (\$ 000)
Research Funding Programs							
Ontario Institute for Cancer Research		81,971	82,092	89,800	77,000	77,000	407,863
Research Infrastructure	✓	67,270	68,524	86,149	80,210	88,426	390,579
Research Excellence	✓	61,854	70,702	112,000	65,032	74,786	384,374
SickKids Research and Learning Tower		–	45,000	30,000	–	–	75,000
Early Researcher Awards	✓	12,352	10,157	3,870	2,713	9,763	38,855
Perimeter Institute		–	5,000	5,000	10,000	10,000	30,000
Grants in support of research and innovation	✓	4,876	641	–	11,850	7,970	25,337
Minor capital investments	✓	–	1,459	15,559	290	197	17,505
Ontario Brain Institute		849	6,590	7,560	–	–	14,999
International Collaborations		–	854	1,300	2,331	2,866	7,351
Neurotrauma Program		–	–	–	–	4,680	4,680
Ontario Post Doctoral Fellowships	✓	2,264	–	430	65	121	2,880
University of Windsor Institute for Diagnostic Imaging Research	✓	–	1,341	1,341	–	–	2,682
Premier's Discovery Awards	✓	1,600	75	–	150	250	2,075
Renewable Energy Project	✓	–	300	300	300	–	900
Premier's Catalyst Awards		580	300	–	20	–	900
Subtotal		233,615	293,035	353,309	249,961	276,059	1,405,980
Programs to Facilitate Commercialization							
Industry-Academic Collaboration Programs (Ontario Centres of Excellence)	✓	–	34,286	31,564	31,002	32,400	129,252
Business Ecosystem Support Fund		11,807	14,673	15,534	17,978	2,019	62,011
Innovation Demonstration Fund		15,578	14,707	11,439	2,652	9,163	53,539
Regional Innovation Centres	✓	–	–	24,836	5,812	6,366	37,014
Business Acceleration Program (MaRS)		–	8,771	10,835	8,420	8,598	36,624
Youth Jobs Strategy – Youth Innovation Fund	✓	–	–	–	15,000	15,000	30,000
Next Generation of Jobs Fund – Biopharmaceutical Investment Program		6,836	7,771	1,964	1,907	–	18,478
Centre for Research and Innovation in the Bio-economy		2,500	3,000	4,000	3,500	3,000	16,000

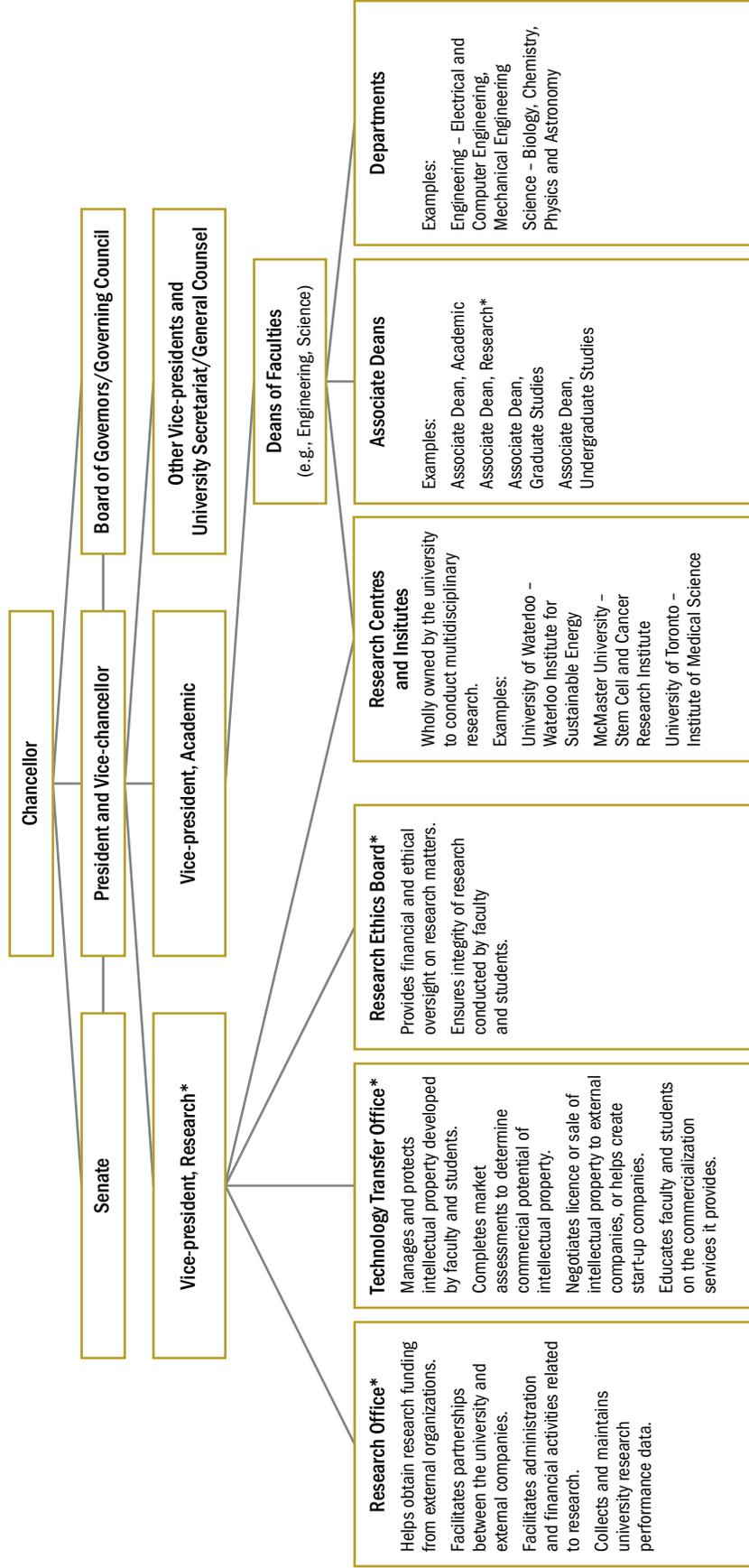
	Applicable to						
	University Research	2010/11 (\$ 000)	2011/12 (\$ 000)	2012/13 (\$ 000)	2013/14 (\$ 000)	2014/15 (\$ 000)	Total (\$ 000)
Ontario Life Sciences Commercialization Strategy		6,040	5,745	718	1,137	1,483	15,123
Next Generation Baycrest Initiative		–	–	4,700	4,915	4,485	14,100
MaRS core funding	✓	–	–	–	5,000	5,000	10,000
Sector Innovation Centres		–	–	–	346	5,325	5,671
Small Business Enterprise Centres		–	–	–	–	4,215	4,215
Subtotal		42,762	88,953	105,590	97,669	97,053	432,027
Risk Capital							
Ontario Emerging Technologies Fund		23,067	27,436	14,500	14,997	8,000	88,000
Northleaf Venture Catalyst Fund		–	–	30,000	20,000	–	50,000
Investment Accelerator Fund		9,667	8,117	8,375	6,522	1,553	34,234
Life Sciences Seed Venture Capital Fund		–	–	–	–	10,000	10,000
Youth Investment Accelerator Fund		–	–	–	5,000	2,000	7,000
Angel Network Program		–	506	612	663	688	2,469
Subtotal		32,734	36,059	53,487	47,182	22,241	191,703
Tax Credits and Initiatives							
Ontario Innovation Tax Credit [R]		–	–	249,834	223,199	172,393	645,426
Ontario Business-Research Institute Tax Credit [R]	✓	–	–	13,111	12,262	20,245	45,618
Ontario Research and Development Tax Credit [NR]		n/a	n/a	n/a	n/a	n/a	0
Ontario Tax Exemption for Commercialization	✓	–	–	–	–	–	0
Subtotal		–	–	262,945	235,461	192,638	691,044
Total		309,111	418,047	775,331	630,273	587,991	2,720,753

[R] Refundable tax credit.

[NR] Non-refundable tax credit. Tax credit is deducted at time of calculating taxes owing, therefore no disbursement by province is necessary. The Ministry of Finance has estimated the amount of taxes forgone for calendar years 2010–2014 to be \$865 million.

Appendix 2—Governance Structure of a Typical University

Prepared by the Office of the Auditor General of Ontario



— Reporting relationship

* Member of the Research Council/Advisory Board

The council/advisory board provides guidance on research activities and the university's research direction; develops partnerships with other institutions; addresses all aspects of research across campuses and related hospitals including commercialization matters as well as industry relations; acts as liaison on research matters with federal and provincial governments; and provides guidance on the university's strategic international research activity and helps determine effective performance indicators for the university's research.

Appendix 3—University Mandates for Overall Research Activity and Technology Transfer Office, for the Universities Visited

Source of data: Universities' website and strategic plans.

Mandate	University of Toronto	McMaster University	University of Waterloo
University Research Activity	To advance research capacity and productivity by attracting and retaining superb talent; by building strategic research programs and linkages of research, education and training; and by leveraging strategic partnerships and resources for the benefit of Canada and the world.	To achieve the next level of research results and reputation by building on existing and emerging areas of excellence; and to attract and retain high-quality faculty and students by making discovery the centre of the learning experience.	Overall, to be recognized as one of the top innovation universities in the world. Specifically, to increase the worldwide impact and recognition of the university's research.
Technology Transfer Office	To help build successful partnerships between industry, business, government, and the University research community and manage the university's portfolio of intellectual property – turning ideas and innovation into products, services, companies and jobs.	To help researchers move their research into society. Specifically, through working with industry, obtaining funding for collaborative research with industry and commercialization funding, protecting work with patents, trade-marks and copyrights, commercializing work, and connecting to support networks.	To promote the commercialization of leading edge intellectual property opportunities by supporting entrepreneurial activities leading to startup company creation, securing licensing partnerships with existing companies, and promoting ongoing research partnerships with commercialization partners; and to support entrepreneurial minded faculty and students in creating startup companies.

Appendix 4—Federal Research Funding Programs, 2013/14

Source of data: Compiled by the Office of the Auditor General of Ontario from federal funding websites and the Council of Ontario Universities' 2013-14 Financial Report of Ontario Universities

Name	Role	Funding Amount to Ontario Universities	
		(\$ 000)	(%)
Canadian Institute for Health Research* (CIHR)	Mandate is to excel in the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products, and a strengthened health-care system. CIHR's 13 institutes provide funding in four research areas: biomedical; clinical; health systems services; and social, cultural, environmental and population health.	346,879	26
Natural Science and Engineering Research Council* (NSERC)	Supports university students in advanced studies, promotes and supports discovery research, and fosters innovation by encouraging Canadian companies to participate and invest in post-secondary research projects.	288,873	22
Canada Foundation for Innovation (CFI)	Provides funding to develop state-of-the-art facilities and equipment in universities, colleges, research hospitals and non-profit research institutions.	208,720	16
Indirect Costs of University Research Program	Covered a portion of the indirect costs associated with research funded by NSERC, SSHRC, and CIHR. These are costs borne by the institution that cannot be attributed to a particular project, such as costs for energy or maintaining IT infrastructure, meeting regulatory requirements or managing intellectual property.	125,141	10
Social Sciences and Humanities Research Council* (SSHRC)	Promotes and supports post-secondary-based research and research training in the humanities and social sciences.	109,140	8
Canada Research Chairs/Canada Excellence Research Chairs (CERC)	Supports universities in efforts to build Canada's reputation as a global leader in research and innovation. It awards researchers and their teams up to \$10 million over seven years to establish ambitious research programs at Canadian universities. Awards are made in priority areas identified in the federal government's science and technology strategy. Priority areas as of December 2014 are: environment and agriculture; health and life sciences; natural resources and energy; information and communications technologies; and advanced manufacturing.	102,018	8
Other		135,482	10
Total		1,316,253	100

* These three agencies are often referred to collectively as the Tri-Council Agencies or the Tri-Agency.

Appendix 5—Provincial Funding for University Research by Ministry and Agency, 2009/10–2013/14

Source of data: Council of Ontario Universities' Financial Reports of Ontario Universities

	2009/10 (\$ 000)	2010/11 (\$ 000)	2011/12 (\$ 000)	2012/13 (\$ 000)	2013/14 (\$ 000)	5-Yr Total (\$ 000)	(%)
Ministries							
Ministry of Research and Innovation (MRI)	160,015	184,820	139,190	217,676	136,394	838,095	43
Ministry of Agriculture, Food and Rural Affairs	48,341	49,502	53,060	52,587	48,044	251,534	13
Ministry of Health and Long-Term Care (MOHLTC)	52,199	44,693	50,254	47,086	51,556	245,788	13
Ministry of Training, Colleges and Universities (MTCU)	30,248	28,379	28,811	29,148	33,167	149,753	8
Ministry of Economic Development, Employment and Infrastructure	2,270	1,518	42,333	53,634	19,072	118,827	6
Ministry of Education	2,547	2,876	4,690	2,761	1,203	14,077	1
Ministry of the Environment and Climate Change	2,709	2,847	1,929	2,267	3,098	12,850	1
Ministry of Natural Resources and Forestry	2,473	1,518	1,435	1,231	1,279	7,936	0
Ministry of Transportation	1,129	2,135	319	943	1,627	6,153	0
Ministry of Children and Youth Services	1,232	649	465	653	226	3,225	0
Ministry of Community and Social Services	514	1,742	557	88	101	3,002	0
Ministry of Municipal Affairs and Housing	0	0	1,000	2,000	0	3,000	0
Ministry of Northern Development and Mines (MNDM)	2	1,024	1,254	0	0	2,280	0
Ministry of Finance	0	0	0	904	1,070	1,974	0
Ministry of Labour (MOL)	0	0	0	800	1,083	1,883	0
Ministry of Citizenship and Immigration	0	0	750	280	0	1,030	0
Ministry of Tourism, Culture and Sport	0	187	38	0	393	618	0
Ministry of Energy	0	0	0	0	92	92	0
Subtotal	303,679	321,890	326,085	412,058	298,405	1,662,117	85
Other Government Agencies or Organizations Delivering Government Services							
Ontario Institute for Cancer Research (MOHLTC)	25,233	24,899	28,007	29,761	0	107,900	6
Ontario Centres of Excellence (MRI)	15,623	10,841	13,339	10,649	0	50,452	3
Cancer Care Ontario (MOHLTC)	3,813	2,250	3,730	4,347	5,105	19,245	1
Workplace Safety and Insurance Board (MOL)	2,267	3,287	3,461	1,724	583	11,322	1
Northern Ontario Heritage Fund Corporation (MNDM)	1,938	1,429	2,067	2,509	1,624	9,567	0
Ontario Problem Gambling Research Centre* (MOHLTC)	644	519	987	1,241	0	3,391	0
Higher Education Quality Council of Ontario (MTCU)	210	362	267	292	0	1,131	0
Office of the Premier	675	0	75	0	0	750	0
Public Health Ontario (MOHLTC)	0	689	0	0	15	704	0
Other grants not listed above	8,132	8,758	11,150	17,735	36,865	82,640	4
Subtotal	58,535	53,034	63,083	68,258	44,192	287,102	15
Total	362,214	374,924	389,168	480,316	342,597	1,949,219	100

* Renamed Gambling Research Exchange Ontario in April 2015.

Appendix 6—Glossary of Terms

Prepared by the Office of the Auditor General of Ontario

Accelerators—Provide office space and management training to start-up companies dedicated to developing and commercializing technology in exchange for equity in a technology. Services include mentorship, access to equipment for prototyping and demonstrations, peer networking, and connecting to investor and alumni networks and access to financing. Time in the space is typically limited to a 3–4 month period and provides start-ups with a small cash investment.

Angel Investor—An individual who invests private capital in a small or newly established enterprise.

Association of University Technology Managers (AUTM)—A U.S. based not-for-profit association of technology managers and business executives who manage intellectual property. The AUTM surveys universities annually on a number of performance measures.

Centres of Excellence—Independent not-for-profit organizations that support and invest in early-stage projects where the likelihood of commercialization is high, as well as provide training and development of innovators and entrepreneurs. There are 49 federal Centres of Excellence and 7 provincial Centres of Excellence in Ontario.

Citation—Acknowledges a source used in a formal academic paper.

Commercialization—The process of taking a discovery or invention to the marketplace.

Disclosure—Communication of key information to a technology transfer office regarding a discovery or new technology for the purpose of allowing the office to make an informed decision on how best to proceed.

Encumbered Disclosure—A disclosure owned by one party (the inventor or university) on which a second party (industry sponsor who provided funding or in-kind contributions) reserves the right to claim ownership.

Entrepreneurship—The capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit.

First to File—A patent system in which the first person to file a patent application for a specific invention is entitled to the patent. In Canada and in most other countries, the first person to file has priority over other people claiming rights for the same invention.

Highly Qualified Personnel (HQPs)—Individuals with university degrees.

Incubators—Similar to accelerators except that start-ups can stay in the space for a much longer period of time and incubators take a much larger amount of equity in exchange for their services.

Innovation—An invention, new technology or new process that is not currently available in the marketplace; an improvement to an existing technology/process that significantly improves functionality, cost or performance; or a significant modification to the application of existing technologies/processes that are applied in a setting or condition for which current applications are not possible or feasible.

Innovation Ecosystem—The participants and resources that transform knowledge into products, processes and services that lead to economic growth and development to improve the standard of living.

Innovation Park—A community of innovators and specialists where academia, industry, government and not-for-profits work together to cultivate ideas, identify and transform important technological discoveries, and propel innovations into the marketplace.

Intellectual Property—Creations of the mind such as inventions; literary and artistic works; designs; and symbols, names, and images used in commerce. They are protected by law through patents, copyrights or trademarks.

Intellectual Property Disclosure Form—A formal document used to declare a new technology and subsequently analyze it for commercial or public value.

Intellectual Property Rights—Ownership of intellectual property and associated rights, such as future income sharing, and royalty-free use.

Licence Agreement—Grants the licensee the right to make, use and sell the specific technology described in the licence. This right can be exclusive (i.e., no one else including the inventor has this right), or non-exclusive (i.e., others may be granted similar rights; in this scenario, the lessee's rights may be limited to a defined geographic area, or for a specific field of use or application).

Licensing an Invention—Allowing a business or individual to manufacture and sell an invention, usually in exchange for royalties.

Licensing Fee—An amount of money that is paid to an owner of intellectual property for the right to manufacture, use or sell the intellectual property. This is usually a fixed amount to be paid at a fixed time as stipulated in a licensing agreement.

Milestone Payment—An interim payment, which is linked to delivering a service or commodity, such that if the service is not delivered, the agreement can be terminated.

Non-disclosure Agreement—A legal contract to protect information considered proprietary or confidential. The parties agree not to disclose information covered by the agreement.

Patent—A government grant giving the inventor the right to exclude others from making, using or selling an invention, from the day on which the patent application is filed with the patent office to a maximum of 20 years. To be granted this exclusive right, the invention must be new, non-obvious and useful with commercial applicability.

Patent Cooperation Treaty (PCT)—An international treaty for standardized filing procedures for foreign patents. The treaty allows for filing patents in a large number of jurisdictions.

Prior Art Status—Anything published before the filing date of a patent that describes the same or similar invention, and therefore could call into question a patent application's claim of originality.

Proof of Concept—The stage during the development of a product when it is established that the product will function as intended.

Prototype—An original or early model of something from which other forms are copied or developed. It is developed to test the feasibility of a concept or hypothesis within a systematic investigation or search.

Provisional Patent Application—A patent application in the United States that preserves the rights of a patent applicant for one year during which time a decision must be made on whether to file a regular patent application. A provisional patent application is not examined but serves as the priority date for applications filed later.

Public Disclosure—Communication of information through verbal presentations, abstracts, posters and papers, in which a person is not obligated to keep the information confidential and may replicate the innovation.

Regional Innovation Centres (RICs)—18 not-for-profit corporations located in Ontario that support technologically innovative firms with high growth potential with appropriate business acceleration services that focus on educational programming, advisory and mentorship programming and access to capital programs.

Research Agreement—A contract to provide funding for a research project. It contains terms and conditions governing the conduct of the project, as well as obligations of the recipient and funder. The agreement also sets out the roles and responsibilities of the parties involved.

Research Park—A property-based venture for research and commercialization that creates partnerships with universities and research institutions, encourages the growth of new companies, translates technology, and drives technology-led economic development.

Research Publications—Typically, academic journals in which scholars publish research that brings discoveries or ideas to the public domain.

Risk Capital—Funds made available to start-up companies and small businesses with growth potential.

Royalty—A percentage of sales or profit paid by the lessee to the owner of intellectual property under a licensing arrangement.

Seed Money—Money allocated to initiate a project.

Start-up/Spinoff Company—A company created by inventors to exploit their intellectual property. This method of commercialization holds the highest risk but can lead to the highest potential rewards for inventors.

Technology transfer—The process of transferring scientific findings from one organization to another for the purpose of further development and commercialization.

Technology Transfer Office—An office at a university that facilitates commercialization by bringing together the institution and industry to transfer research discoveries to the marketplace.

Appendix 7—Recommendations Applicable to Universities

Prepared by the Office of the Auditor General of Ontario

Recommendations 1–6 are applicable to the Ministry of Research and Innovation.

Recommendation 7:

In conjunction with government sponsors, universities should develop socio-economic performance measures to better communicate the outcomes of their research and commercialization efforts.

Recommendation 8:

Universities should review their research reporting requirements on performance measures, and identify opportunities to report more detailed information in the annual research report and in management reports going to senior management.

Recommendation 9:

To ensure that all intellectual property created with university resources is disclosed, universities should:

- develop guidelines to help faculties assess university resources in the creation of intellectual property and to require such assessments be documented;
- clearly communicate invention disclosure requirements during technology transfer office presentations to staff and students;
- require all faculties to use only disclosures made directly to the technology transfer office for performance review purposes; and
- use research grant status reports sent to research funders to anticipate and track completeness of disclosures.

Recommendation 10:

In the absence of objective criteria to assess the commercial potential of disclosures, university technology transfer offices should develop a formal process to discuss and challenge decisions on commercial potential, including assessments undergoing a second level of review.

Recommendation 11:

To help ensure commercialization assessments are completed within a reasonable timeframe to avoid delays in patent filings, university technology transfer offices should:

- establish time frames to complete assessments based on technology type or complexity of invention; and
- formally track and review how long it takes to complete assessments, and address any delays identified.

Recommendation 12:

To help ensure intellectual property is properly protected, universities and/or their technology transfer offices, as applicable, should:

- ensure contracts with faculty associations and researchers include provisions to make them aware of the importance of not disclosing inventions prior to filing for patent protection; and
- file for patent protection as early as possible, where appropriate, to minimize the risk of others filing first and precluding them from obtaining a patent.

Recommendation 13:

To permit efficient management review of commercialization decisions and efforts and to help facilitate knowledge transfer among personnel in case of staff turnover, universities should:

- develop case management documentation guidelines; and
- ensure that commercialization decisions and actions are clearly and consistently documented in accordance with the guidelines to be developed.

Recommendation 14:

To manage costs incurred in the effort to commercialize intellectual property, university technology transfer offices should implement formal policies and guidelines regarding cost management, and track costs incurred by type (e.g. legal costs, patent fees, and marketing) for each disclosure.

Recommendation 15:

To help ensure the timely and accurate collection of revenue owing, all universities should:

- ensure they have an accurate and up-to-date tracking payment schedule that includes due dates, so that universities can bill one-time payments in advance and remind licensees to submit royalty payments on time;
- obtain sales and revenue reports from licensees to support the amount of royalties remitted;
- develop criteria to help assess when it is worthwhile to ask for an audit report (for example, when royalty payments are dependent on sales generated); and
- enforce the interest penalties stipulated in contracts to encourage licensees to submit revenue payments on time.