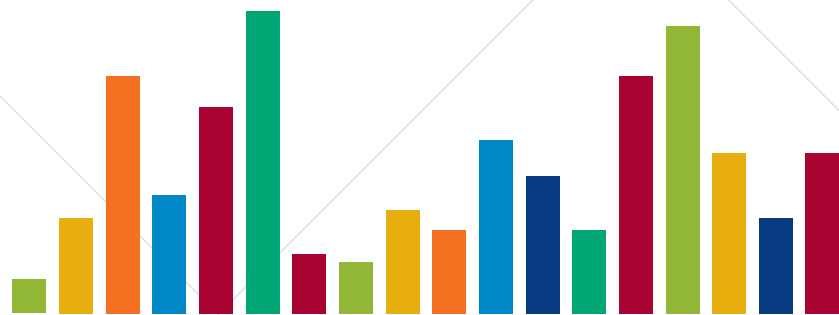


FY2016

AUTM Canadian Licensing Activity Survey



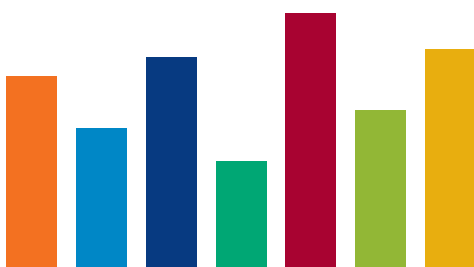
A Survey of Technology Licensing
and Related Activity for Canadian
Academic and Nonprofit Institutions
and Technology Investment Firms



AUTM Canadian Licensing Activity Survey **FY2016**

TABLE OF CONTENTS

Executive Summary	3
The Better World Project Increasing Mobility for Amputees <i>Holland Bloorview Kids Rehabilitation Hospital</i>	5
Research Funding	6
The Better World Project A Better Way to Feed the Planet <i>Université de Montréal</i>	7
Disclosures	8
The Better World Project Activity Monitoring for Wheelchair Users <i>University of Alberta</i>	9
Patents	10
The Better World Project Identifying Safer, More Effective Molecular Drug Candidates <i>Université de Montréal, McGill University and Université de Sherbrooke</i>	12
Licenses and Options	13
The Better World Project Anonymizing Health Care Information for Higher Use <i>Children's Hospital of Eastern Ontario (CHEO) Research Institute Inc., University of Ottawa</i>	15
Start-Ups	16
Data Appendix	17
About the Survey	18
Suggested Citation	18
About AUTM	18



EXECUTIVE SUMMARY

Academic Research Commercialization Creating Opportunities

This year's survey of nearly three dozen academic institutions and hospitals across Canada reveals strong levels of licensing activity and start-up creation, two key measures of successful technology transfer. Gross income from licensing jumped significantly in 2016, bringing in \$72.7 million, a healthy jump of 13 percent over the previous year, to participating institutions that will in turn fund the development of new intellectual property.

Licensing activity at the 35 participating Canadian institutions continued an upward trend begun in 2009. A total of 927 new license and option agreements were executed in 2016, including 336 new exclusive licenses, 424 new nonexclusive licenses and 167 options.

Driving the Entrepreneurial Economy

A recent study from AUTM and the Biotechnology Innovation Organization (BIO) shows that academic-based research boosts local, national and global economies. Technology transferred from research institutions to the marketplace helps create jobs through new start-ups and product sales, and contributes to the evolution of new industries.

Start-up creation has been rising at participating institutions, reflecting a strong entrepreneurial environment in Canada. Survey respondents reported 100 new start-ups in 2016, compared with just 68 in 2011 and 48 in 2009.

Is everything rosy? No.

Declining Research Funding and Disclosures

Total research expenditures declined to \$6,066 million, continuing a downward trend since 2009. The decreases in federal and industry funding were offset slightly by funding from alternative sources, which grew 7 percent.

Fewer patent filings in 2016 are likely associated with the decline in federal research expenditures and lower disclosure rates. Reported disclosures have been decreasing since 2009. In 2016, only 1,697 disclosures were reported, 224 fewer than in 2009.

What does it all mean?

Technology transfer continues to be an important driver of impressive gains for local, provincial and national economies. Without this work, as supported by a strong patent system protecting intellectual property, innovations would linger on lab shelves, their life-changing impacts never realized. It's a better world because of academic research commercialization. The 2016 Canadian Licensing Activity Survey bears that out.



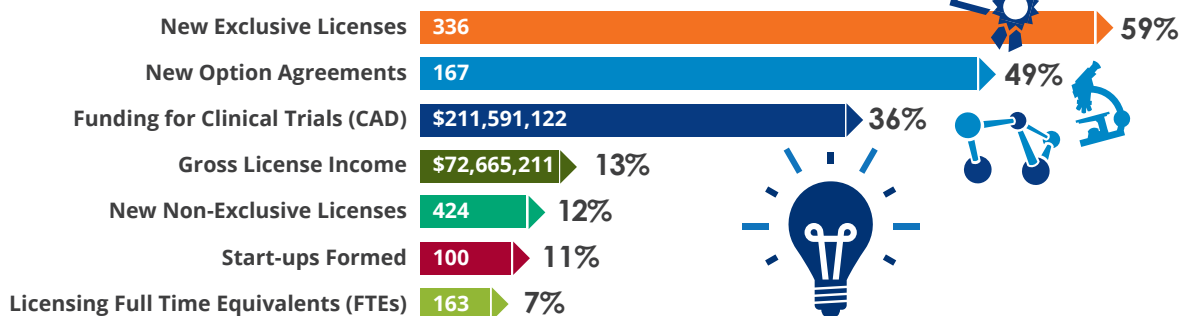
Ragan Robertson

Cabinet Chair, AUTM Metrics and Surveys Portfolio

AUTM Canadian Licensing Activity Survey **FY2016**

TECHNOLOGY TRANSFER GROWTH

Percentage Increases over 2015



The BetterWorld Project

Increasing Mobility for Amputees

*Holland Bloorview Kids
Rehabilitation Hospital*



Worldwide, about 30 million people require a prosthetic device to walk, yet only 10 percent of those individuals have access to the devices. Prosthetic devices available in developing countries are often rudimentary and do not offer the functionality of advanced prostheses, which can cost up to \$50,000.

Inventor Jan Andrysek, Ph.D., a scientist at Bloorview Research Institute at Holland Bloorview Kids Rehabilitation Hospital and an assistant professor at the University of Toronto, has created a more affordable solution for individuals for whom advanced prosthetics are out of reach.

The All-Terrain Knee is an innovative, mechanical prosthetic knee joint that is stable, durable and waterproof. The invention includes a proprietary stance-phase control mechanism (the AutoLock) and a swing-phase control mechanism that allows the knee to securely lock itself without impeding natural movement. The prosthetic knee is easy to fit and maintain, and can be used in harsh environments.

Andrysek established partnerships with rehabilitation centres to develop fitting procedures and teamed with the International Committee of the Red Cross to conduct clinical studies with the All-Terrain Knee. The inventor says the study results provide strong empirical evidence that the device provides users with a greater feeling of security and a reduction in falls.

In 2014, the technology was licensed to LegWorks Inc., a for-profit social enterprise established to commercialize the artificial knee joint. Today, the company offers four versions of the All-Terrain Knee with various features appropriate for different users, from sedentary to more athletic patients. LegWorks has reached patients in 28 countries, tiering its pricing to help reach underserved patient populations.

According to Andrysek, amputees fitted with the All-Terrain Knee can engage in everyday activities more quickly and efficiently, whether that's working or taking care of family.

AUTM Canadian Licensing Activity Survey **FY2016**

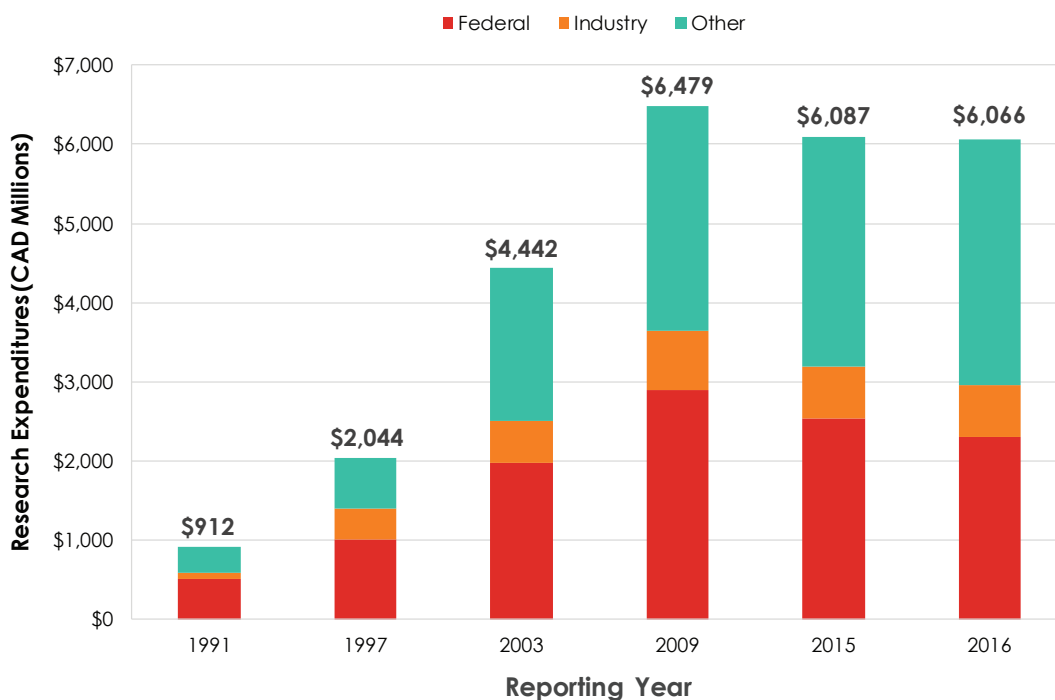
RESEARCH FUNDING

Research conducted in academic institutions provides the foundation for the innovation economy in Canada — leading to groundbreaking technologies and lifesaving medical treatments.

Key Findings

- ▶ Total research expenditures fell slightly to \$6,066 million in 2016 from \$6,087 million in 2015, continuing a general downward trend since 2009.
- ▶ Federal funding, \$2,306 million, and industry funding, \$652 million, decreased 9 percent and 2 percent, respectively, from 2015.
- ▶ The declines in federal and industry funding were slightly offset by increases in alternative sources of funding, including provincial government and foundation support. Funding from these sources jumped 7 percent, from \$2.89 million in 2015 to \$3.11 million in 2016.

TOTAL RESEARCH FUNDING FALLS



The BetterWorld Project

A Better Way to Feed the Planet

Université de Montréal



The widespread use of antimicrobials to prevent disease and promote growth in food animals has contributed to the emergence of antimicrobial bacteria resistance (ABR), a significant global health threat compounded by growing demand for animal protein and a shift toward intensive livestock production in developing countries.

To address this problem, experts in swine pathogenic bacteriology at the Université de Montréal developed a series of live vaccines to immunize pigs against diseases that typically require antibiotic treatment. The Coliprotec® vaccines were developed by John M. Fairbrother, Ph.D., and Eric Nadeau, Ph.D., from the Department of Pathology and Microbiology of the Faculté de médecine vétérinaire.

The new vaccines immunize pigs against post-weaning diarrhea (PWD) and edema disease (ED), both of which are associated with various strains of the bacteria *Escherichia coli* (E. coli). PWD and ED, which occur around the globe and are a common cause of mortality and growth delays in piglets, pose a serious threat to the swine production industry.

In addition to offering the potential to reduce the use of the antibiotics, the Coliprotec vaccines can also substitute for zinc oxide, another PWD preventative that threatens the environment and promotes antibiotic resistance. The single-dose vaccines can be administered in the pigs' drinking water, greatly reducing both labour costs and animal stress.

In 2003, the researchers founded Prevtec Microbia and in 2005 were granted an exclusive worldwide license from Univalor, through Valorisation-Recherche Limited Partnership, to manufacture and commercialize the Coliprotec technology. In 2013, Prevtec Microbia purchased the intellectual property for Coliprotec and other technologies from the university.

With the help of distribution partner Elanco Animal Health, a division of Eli Lilly & Co., the company is selling its line of award-winning vaccines in more than 33 countries, while continuing to collaborate with Univalor and the university on new ways to improve animal health and production performance as well as food safety for humans.

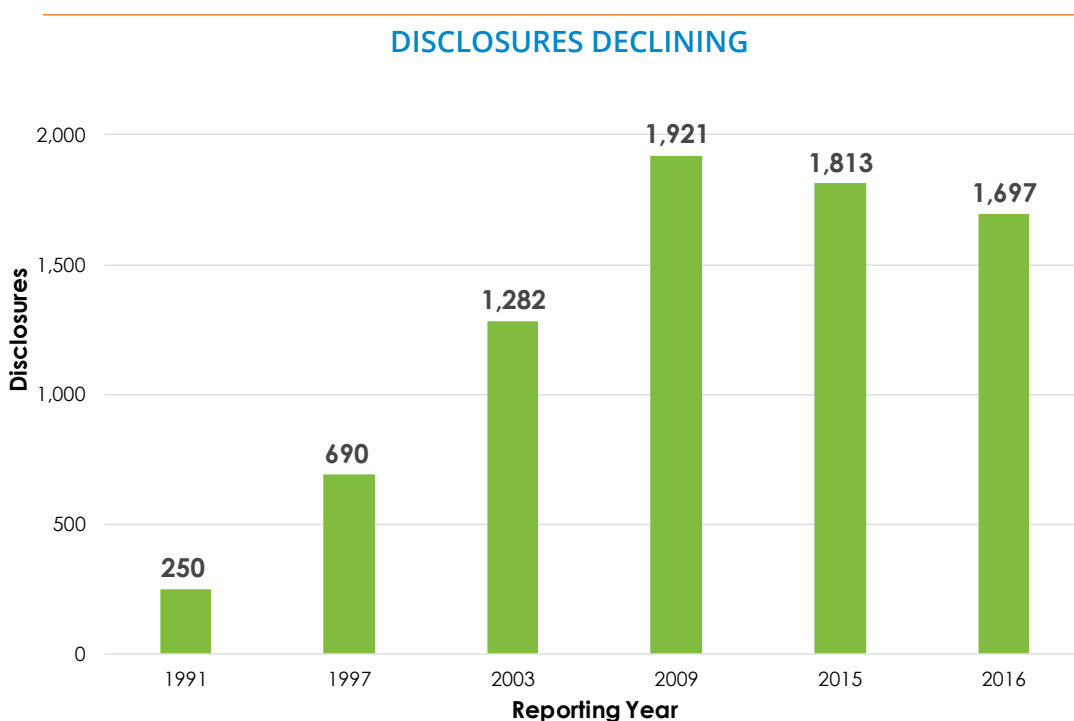
AUTM Canadian Licensing Activity Survey **FY2016**

DISCLOSURES

Discoveries born out of research can lead to more impactful applied research, new commercial products and new companies. The movement of those discoveries and knowledge from the university to the market to benefit the public is technology transfer, a collaborative process that begins when the inventor discloses an invention to the university. The invention disclosure is the launching pad for evaluating the technology, analyzing the market and developing strategies for protecting the intellectual property.

Key Findings

- ▶ The number of disclosures at participating Canadian research institutions declined to 1,697 in 2016, a 6 percent decrease from 2015 and a drop of more than 11 percent from their peak in 2009.





The BetterWorld Project

Activity Monitoring for Wheelchair Users

University of Alberta



Researchers from the University of Alberta have applied wearable technology to the wheelchair to help prevent shoulder injuries and generate a trove of accessibility data to users. With help from tech transfer partner TEC Edmonton and the start-up company Redliner Inc., the device is making its way to market.

When Martin Ferguson-Pell, Ph.D., learned that 66 percent of wheelchair users with a spinal cord injury experience shoulder pain and injury, he was inspired to help reduce wear and tear to users' shoulders. He and his team developed a "wearable" device that could be attached to the wheel to collect measurements including the number of strokes or pushes, the length of the stroke, the rolling resistance and the distance covered. The propulsion parameters are then relayed to the user's smartphone or web dashboard.

Feedback from the device also includes the incidence of "redliner" events, or the number of times the wheelchair user exceeds an exertion level that is likely to produce an injury. For users who are consistently overexerting their upper extremities, the data can help make a case for a power-assisted chair or for more accessible work environments.

The technology management team at TEC Edmonton, a joint venture between the University of Alberta and Edmonton Economic Development, connected Ferguson-Pell with Calgary entrepreneur David Evans, who founded Redliner and licensed the exclusive rights to developing, manufacturing and selling the battery-operated Redliner™ device around the world. The Redliner has the accessibility characteristics of a typical wearable: The company anticipates the cost of the device to be around \$100 and have a battery life of about four days.

Evans plans to continue collaborating with Ferguson-Pell's group, which hopes to develop an anonymized repository of data from users to help researchers understand the root causes of shoulder injury and to identify wheelchair-accessible routes.

AUTM Canadian Licensing Activity Survey FY2016

PATENTS

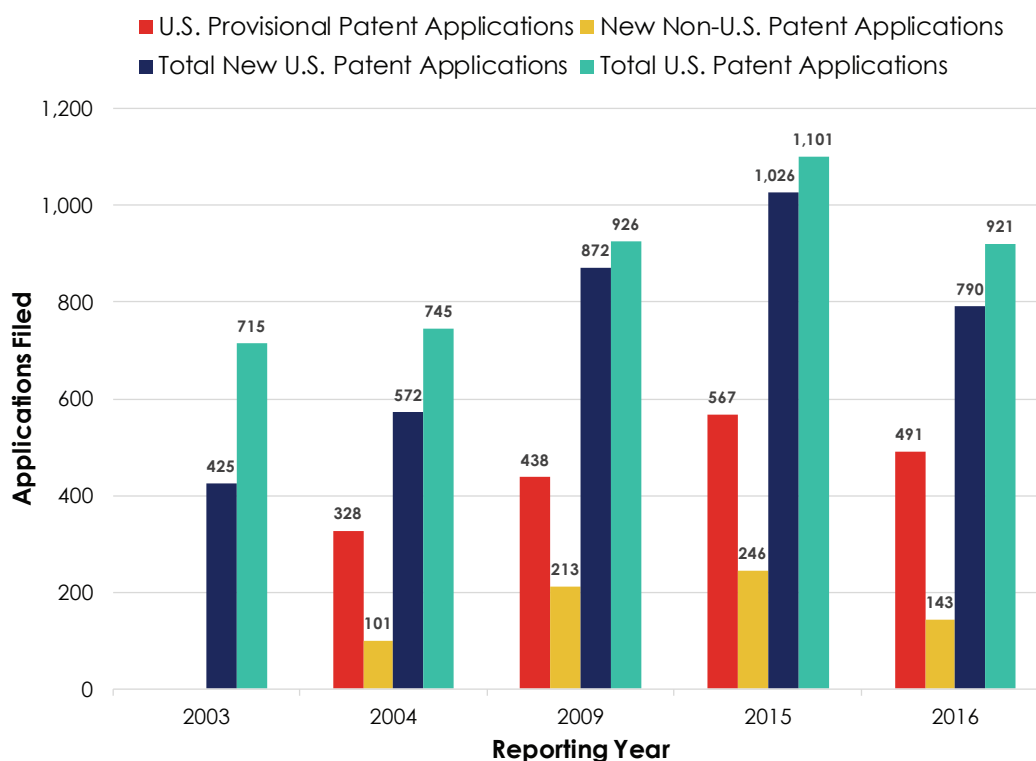
A key step in the transfer of technology is the protection of potentially useful ideas as intellectual property. Patent protections provide economic incentive for entrepreneurs and companies to invest in new technologies. This is especially important for inventions that require the commitment of significant financial and technical resources over a long period to develop into marketable products.

Protecting intellectual property begins with the filing of a patent application with patent offices. Patent activity in Canadian institutions had generally been rising until 2016.

Key Findings

- ▶ Patent activity decreased in 2016, suggesting that technology transfer offices are being increasingly selective in their pursuit of patent protection for intellectual property developed at their institutions.
- ▶ The number of new U.S. patent applications filed was 790, followed by 491 U.S. provisional applications and 143 new non-U.S. applications.
- ▶ New non-U.S. patent applications took the biggest dip, dropping 43 percent from 2015.
- ▶ The reduced number of patent filings may also be associated with a decline in federal research expenditures and lower disclosure rates, which have been falling since 2009.
- ▶ Canadian research institutions spent \$14.4 million on external legal fees for patents and copyrights in 2016, which were similar to 2015 spending levels.
- ▶ Reimbursed legal fees, which were \$6.3 million in 2016, have remained essentially flat since 2014.

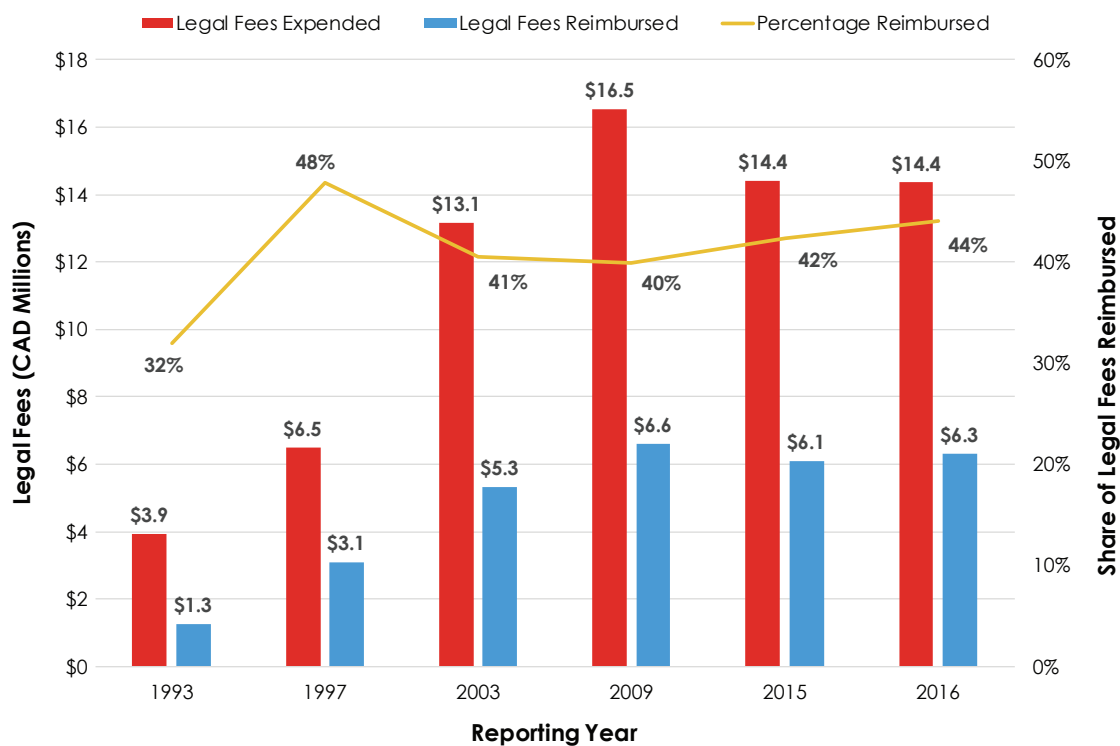
PATENT ACTIVITY FOR CANADIAN INSTITUTIONS



U.S. PATENT APPLICATIONS FILED AND ISSUED

	2011	2012	2013	2014	2015	2016
Total U.S. Patent Applications Filed	951	998	1,025	1,024	1,101	921
Total U.S. Patent Applications Issued	181	178	240	276	271	257

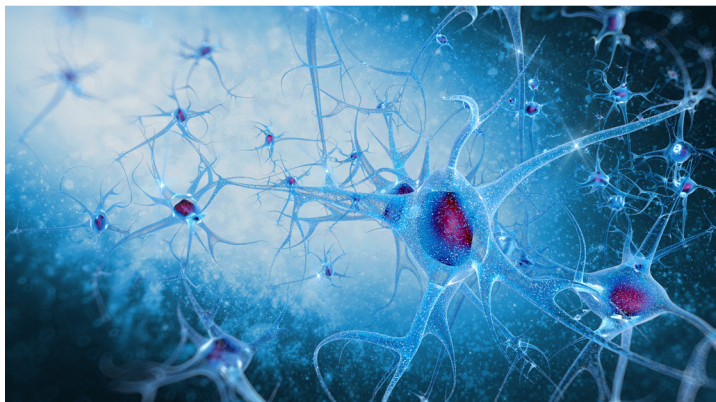
REIMBURSED LEGAL FEES



^{The} **BetterWorld Project**

Identifying Safer, More Effective Molecular Drug Candidates

*Université de Montréal,
McGill University and
Université de Sherbrooke*



In both the human body and the field of molecular pharmacology, proteins known as G protein-coupled receptors (GPCRs) are superstars.

When naturally occurring molecules (called ligands) bind to GPCRs, the complex hubs prompt much of the cellular activity in the body, including metabolism and brain function, by activating signalling pathways. Different ligands change the shape of GPCRs, which in turn, alters the signals sent.

Drug makers exploit this cell function by engineering artificial ligands that will bind to GPCRs and selectively activate signalling pathways to achieve a specific therapeutic response. However, scientists haven't come close to tapping the potential therapies available through ligand-based signalling.

To help scientists predict the efficacy and side effects of candidate molecules, Michel Bouvier, Ph.D., and Graciela Pineyro, M.D., Ph.D., from the Université de Montréal (UdeM); Stéphane Laporte, Ph.D., and Terry Hebert of McGill University; and Richard LeDuc, Ph.D., from Université de Sherbrooke developed a set of biological tools called GPCR biosensor technology. The research team received a multiyear grant from the Quebec Consortium for Drug Discovery to develop the platform.

In 2013, UdeM's Institute for Research in Immunology and Cancer – Commercialization of Research (IRICoR) negotiated a partnership among McGill, UdeM and Domain Therapeutics, exclusively licensing the GPCR biosensor technology to the French biotech company. As part of the agreement, the company established a Montreal-based subsidiary that provides GPCR analysis to a wide range of clients from both academia and the biopharmaceutical industry.

Today, Domain Therapeutics is identifying and developing new drug candidates for improved treatments for the central nervous system and oncology, in addition to providing access to its technologies through research and collaborative agreements.

From initial project funding to the inter-university partnership and a committed industry partner, the development of the GPCR biosensor and its commercialization are a testament to what can be achieved through collaboration.

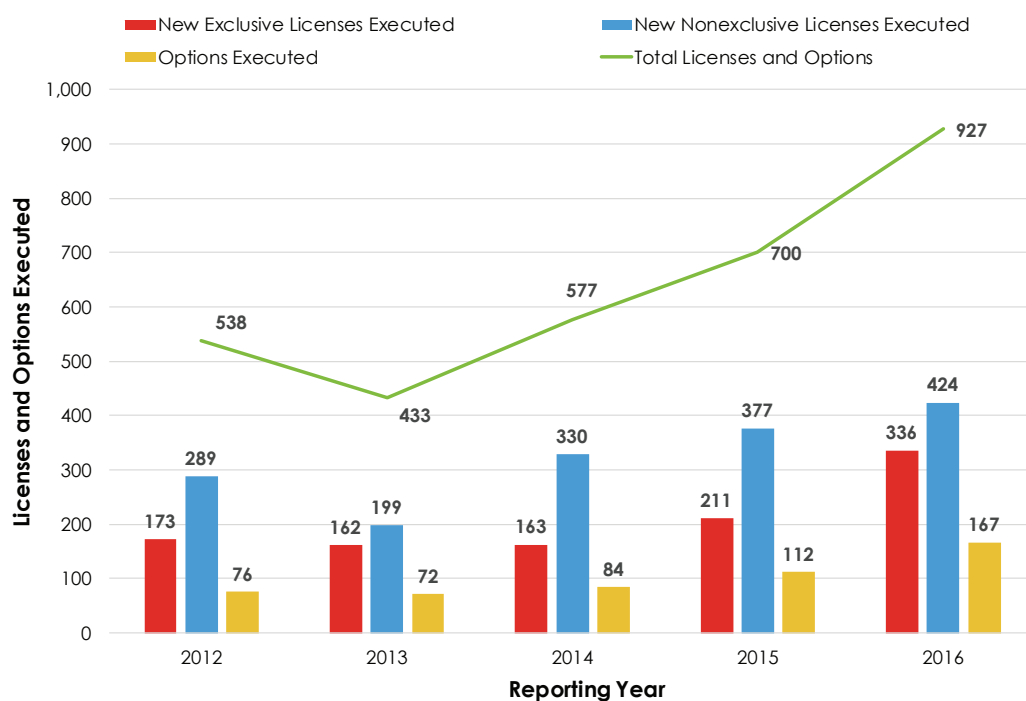
LICENSES AND OPTIONS

After the technology's intellectual property is protected, usually in the form of a patent application, the technology transfer office determines the best way to transfer that technology to the marketplace. This is often accomplished through a license either to develop the technology further or get it out to the marketplace in its current state. In 2016, innovations continued to make their way from research institutions to commercial entities.

Key Findings

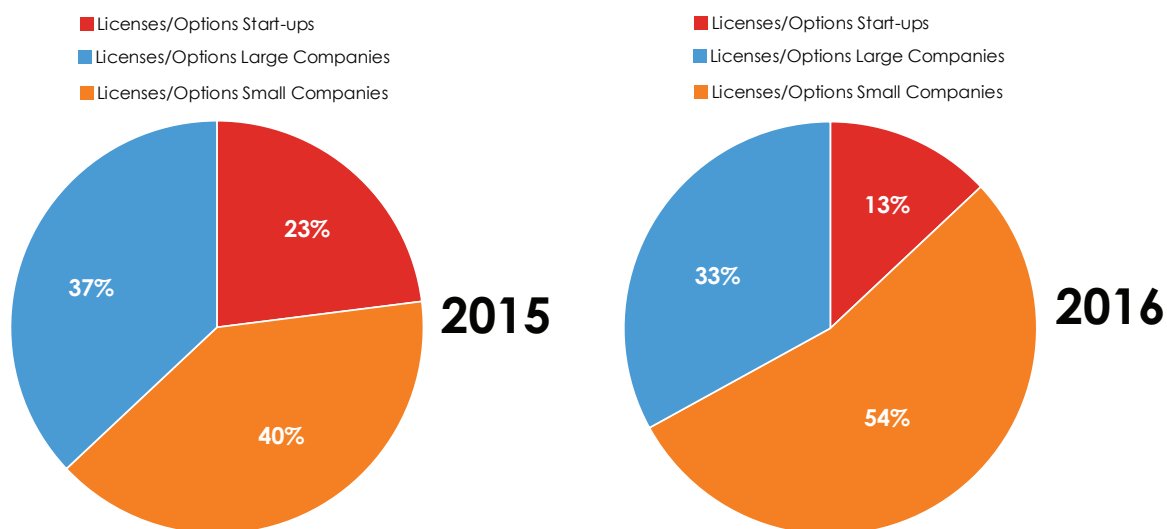
- ▶ A total of 927 new licenses and option agreements were executed in 2016, an increase of 32 percent over 2015.
- ▶ The number of new exclusive licenses grew 59 percent to 336.
- ▶ New nonexclusive licenses increased to 424, a gain of 12 percent over 2015.
- ▶ The 167 new option agreements represented a 49 percent increase over the prior year.
- ▶ Most license agreements executed in 2016 were with established companies, more than half of which were small, an increase in share of 14 percentage points from 2015. One-third of licenses went to large companies, down 4 percentage points from 2015. Despite an increase in start-up formation in 2016, licensing to new companies decreased 10 percent over 2015. Canadian institutions sought equity in 75 percent of the new start-ups.
- ▶ The survey respondents reported a total of 3,417 active licenses in 2016.
- ▶ Gross reported licensing income jumped to \$72.7 million in 2016 from \$64.4 million in 2015.
- ▶ As in previous years, the majority (\$46 million) of licensing income came from running royalties.
- ▶ The Other Income category, represented by milestone payments, annual license fees, signing fees and lump sum payments, has been on the rise since 2009 and increased 35 percent in 2016.
- ▶ Cashed-in equity, however, remained low at \$3.5 million.

LICENSES AND OPTIONS ON THE RISE

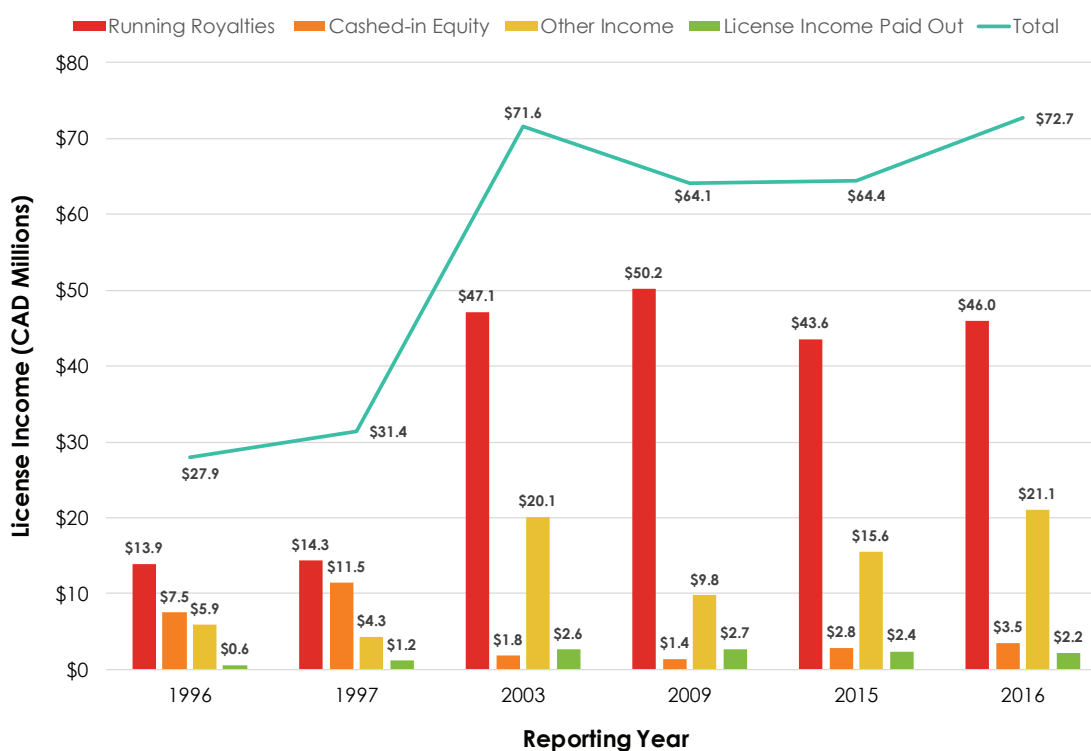


AUTM Canadian Licensing Activity Survey FY2016

LICENSES AND OPTIONS EXECUTED WITH SMALL, LARGE AND START-UP COMPANIES



LICENSE INCOME BY SOURCE





The BetterWorld Project

Anonymizing Health Care Information for Higher Use

*Children's Hospital of Eastern Ontario (CHEO) Research Institute Inc.,
University of Ottawa*



With the increasing digitization of health care data, concern has grown over the privacy of personal information. But for health researchers, the cumulative data in patient medical records represent a treasure trove of information that could help reduce health care costs, allocate resources more efficiently and rapidly detect disease outbreaks.

"Everybody wants this data," said Khaled El Emam, a professor at the University of Ottawa (uOttawa) and a senior investigator at the Children's Hospital of Eastern Ontario (CHEO) Research Institute. "Data has a lot of value and can bring about a lot of societal benefits when it is shared and analyzed. But the bottom line is that this has to be done in a way that is protective of privacy."

To protect individual patient information while preserving data usability, El Emam developed software called the Privacy Analytics Risk Assessment Tool (PARAT). The digitalized solution is based on patented scientific analysis called "de-identification," which strips out key data elements that could be used to connect individual records to patients.

In 2007, El Emam founded a spin-off company, Privacy Analytics Inc. (acquired by IMS Health, now IQVIA, in 2016) and launched the PARAT solution commercially two years later. At CHEO, the solution solved a long-standing problem for pediatric hospital pharmacists who wanted to benchmark drug utilization by making the privacy risks easier to manage.

"The university has been very supportive of commercialization," said El Emam, who is CEO of Privacy Analytics. "Most of our employees are uOttawa grads, so the process has allowed us to keep the best and the brightest here as well as to generate interest among the student body, getting them thinking about how to commercialize their ideas and deploy them in the real world.

"Commercialization is a great way to shorten the normally lengthy process of translating research into practice," he said.

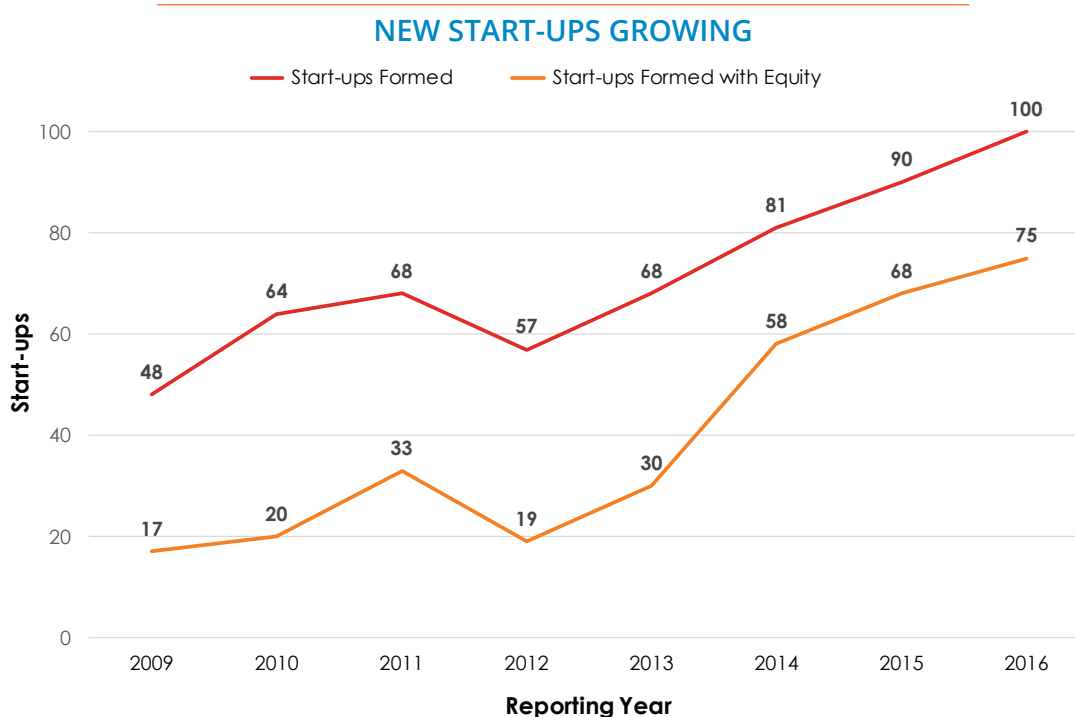
AUTM Canadian Licensing Activity Survey **FY2016**

START-UPS

The innovations born out of academic research often lead to the formation of new companies that develop new products, create jobs and spark economic growth.

Key Findings

- ▶ The number of companies formed on the basis of institutional research has been on the rise in Canada since 2009. One hundred start-ups were established in 2016, compared with 48 in 2009.
- ▶ As in 2015, most of these start-ups reside in the institution's home province, 89 percent in 2016 and 91 percent in 2015.
- ▶ Of the total number of start-ups established by Canadian research institutions since the annual licensing survey began collecting relevant data in 1994, 564 start-ups were still operational in 2016, an increase of 8 percent from 2015.



START-UPS FORMED EACH YEAR

	2011	2012	2013	2014	2015	2016
Start-ups Formed	68	57	68	81	90	100
Start-ups Formed with Equity	33	19	30	58	68	75
Cumulative Start-ups Operational	684	609	607	481	521	564



ABOUT THE SURVEY

AUTM invited 70 Canadian research institutions, not all research intensive, to participate in the AUTM Canadian Licensing Activity Survey: FY2016. Thirty-five institutions responded for a response rate of 50 percent. This compares to the 2015 survey, which had 36 respondents for a response rate of 51 percent. It is important to note that not all respondents reply to all the questions. Therefore, response rates to any given question will vary, and some subcategories are not completely represented.

Most of the data collected in this survey is also available in AUTM's Statistics Access for Technology Transfer (STAT) database. To access this searchable database of more than 25 years of academic licensing data, visit www.autm.net/stat.

SUGGESTED CITATION

Association of University Technology Managers®, report titled ***AUTM Canadian Licensing Activity Survey: FY2016, A Survey Report of Technology Licensing (and Related) Activity for Canadian Academic and Nonprofit Institutions and Technology Investment Firms*** can also be referenced by its abbreviated title, ***AUTM Canadian Licensing Activity Survey: FY2016***, editors Maya Collumn, Maya Medeiros, Olivia Novac, Ben Rogers, Jean-Claude Sabourin and Tony Wigglesworth, with research assistance by Chrys Gwellem.

ABOUT AUTM

The Association of University Technology Managers is the nonprofit leader in efforts to educate, promote and inspire professionals, throughout their careers, to support the development of academic research that changes the world. AUTM's community comprises more than 3,200 members who work in more than 800 universities, research centres, hospitals, businesses and government organizations around the globe.



One Parkview Plaza, Suite 800
Oakbrook Terrace, IL 60181 USA
Phone: +1-847-686-2244
Fax: +1-847-686-2253
info@autm.net

