



Innovation and the Human Brain

CREATING VALUE FOR ONTARIO AND LEADING THE WORLD

SUMMARY REPORT
JULY 2011



Public Policy Forum
Forum des politiques publiques

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© 2011, Public Policy Forum
1405-130 Albert St.
Ottawa, ON K1P 5G4
Tel: 613.238.7160
Fax: 613-238-7990
www.ppforum.ca

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ABOUT THIS REPORT

On May 16th 2011, IBM, Baycrest and the Public Policy Forum convened *Innovation and the Human Brain*. This conference was convened, in part, at the request of the Minister of Research and Innovation in an effort to bring together business, academia and government to tackle one of the main issues which will define Ontario's innovation agenda over the coming decade – brain research.

Ontario is making substantial new investments in the field of brain research. With the leadership of top academic institutions and private-sector researchers, and with carefully crafted public support, Ontario is becoming a global centre of excellence in brain research and innovation. This focus is critical for the province, both economically and socially. Emerging from the recession, the province must have a renewed focus on improving productivity, and innovation, especially in areas of strength, is central to achieving this. Moreover, there are pressing societal concerns which also compel us to explore ways to enhance our innovation capacity around the human brain. An aging population, coupled with increasingly unsustainable healthcare costs makes innovating in critical areas, such as neurological diseases, an imperative. The need for a focus on innovation and the human brain is clear.

To this end, the top minds in the field convened to explore the issue in-depth. Participants in the conference were drawn from the public, private, government and non-profit sectors to join a day-long discussion of emerging research in the field of brain science, and to explore how they can work together across disciplines, sectors and borders to advance Ontario's leadership in innovation and the human brain.

To achieve success, there must be leadership and collaboration across all sectors. Discussions throughout this symposium focused on Ontario's strengths in this area, and highlighted emerging and existing institutional factors which will greatly help in further enhancing the province's innovation capacity.

This report presents the research discussed, and also provides insight into how participants felt public policy, academic practices and business partnerships could better enhance the province's capacity to meet its goal. As the presenting partners of this event, it is our pleasure to provide you with this look into *Innovation and the Human Brain*. Based on the outcomes of this conference, we firmly believe that with the proper actions by all parties Ontario can and will gain a global advantage in brain innovation.

Dr. William Reichman
President and CEO
Baycrest

Don Aldridge
General Manager
Research and Life Science
IBM Canada

Paul Ledwell
Executive Vice-President
Public Policy Forum





INTRODUCTION

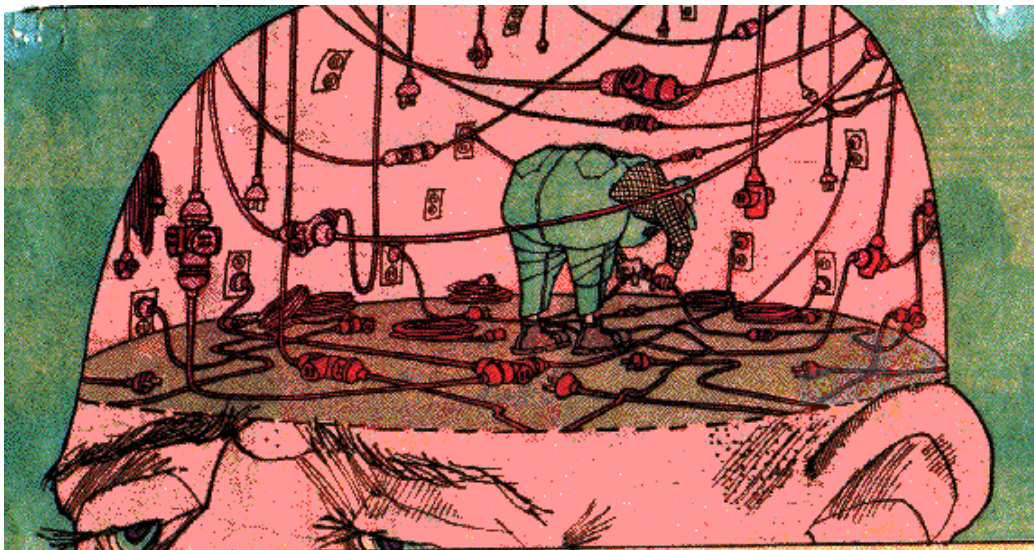
Why explore innovation and the human brain – and, why make doing so a key innovation objective for Ontario? Answering these questions requires a holistic understanding not just of the particulars of brain innovation, but of how this single area of research stretches throughout the innovation system, and how Ontario has the unique capabilities to leverage these connections to achieve excellence.

Held in May of 2011 at the IBM Software Lab in Markham, Ontario, *Innovation and the Human Brain* was designed to explore how Ontario is poised to become a global leader in brain research, and how this would require a system-wide effort from leaders across the innovation ecosystem. The conference drew on a wide pool of participants, as is completely necessary in a field as diverse as brain research. Like the topic it studies, research into the human brain is made up of thousands of interconnections built across sectors, organizations, and individuals to form a dense web of ideas. It is this cross-sector

collaboration that drives innovation throughout the province, and coupled with Ontario's world leading research capacity, has the potential to create a global advantage for Ontario in brain innovation.

Brain innovation is not confined to medical research; it has grown to be a truly cross-disciplinary enterprise. One need only to look at the cutting-edge research being done at IBM, the new virtual brain modeling from Baycrest's Rotman Research Institute or the revolutionary use of new imaging technologies at the University of Western Ontario to see that universities, businesses, the voluntary sector and the government are all deeply involved in advancing brain innovation. Collaboration is the key driver behind these successes, and will be the defining feature of Ontario's global leadership in brain innovation.

Innovation and the Human Brain brought the leading minds in Ontario to discuss the future course for brain innovation – and with effective cross-sector collaboration, the consensus is clear: Ontario is poised for great success.



WHAT IS INNOVATION, AND HOW CAN WE IMPROVE IT?

To begin the conference, the aim of the first discussion was to define, and perhaps to unify, the concept of innovation – after all, to pursue the objective of being a world-leading centre of brain innovation, we must first be in agreement as to what that goal entails.

In addressing this issue, presenters were strongly aligned in proposing that the key to defining innovation is added value. Specifically, innovation takes an idea, or an invention, and creates value in the economic marketplace, or leads to increased quality of life. Improving innovation is not just desirable for the benefits its can return economically, it is also a social imperative. Canada has a growing prosperity gap with the United States, driven largely by our lower productivity. The root cause of this productivity gap is an innovation gap. To create economic and social prosperity, we must innovate. Canada is certainly no stranger to efforts to boost innovation. Decades of reports, countless commissions and endless advice has told policy-makers that the country has a problem. Yet, we seem to lack the key spark to actually make the necessary improvements. The solution here is perhaps not what we do, but how we do it.

The success of mechanisms by which we improve innovation in Canada, and specifically within the field of brain research in Ontario, lies in the nature of the collaborations which drive innovation. To get innovation to work for us effectively, we must foster early and constant collaboration between industry, academia and government. The key in this process is industry. Canada already has some of the most effective academic research support in the world, and

billions have been spent to fund this research over the last ten years. While this is certainly desirable, and a foundational element of the innovation system, these investments are not reaching their full potential without collaboration with industry. Business is the catalyst in innovation – it is the mechanism by which added value is realized. To support innovation we must have industry at the table from the very beginning.

What is innovation?

Joseph Rotman

In order to recognize how to advance society through innovation, we must first understand what we mean by innovation. Our understanding of the idea should recognize that:

- Innovation puts ideas to work
- Innovation creates value
- Business is a catalyst in innovation
- Innovation meets needs to create economic value to enhance quality of life

While Canada has invested much in research, we have yet to see much resulting improvement in innovation. This is perhaps because current policies drive invention, rather than innovation. To correct this issue, business must be at the table early and often in any innovation endeavor, in order to spark the creative collaborations that are required to build the added-value that makes a breakthrough an innovation.

BUSINESS AT THE TABLE

Involving business in innovation efforts is no novel concept – indeed, industry collaboration is a prerequisite for many forms of research funding. But, what participants at *Innovation*





and the Human Brain stressed was that industry must not be the tag-along, or the late addition to the team – industry must be there right from the get-go.

While in the past researchers may have encountered a dearth of potential industrial collaborators, this is no longer true, particularly in the case of Ontario brain research. New structures, such as industry collaboration mechanisms built in to the Ontario Brain Institute, are moving to ensure the full involvement of industrial partners. For their part, academic institutions and governments must work to tailor particular supports to researchers in order to create a strong incentive to commercialize ideas and must adjust certain institutional practices like industry-liaison offices, to be more effective.

The infusion of business in the innovation cycle as early as possible should begin while future innovators are still students. Inclusion of some

business training into science and engineering curricula is essential. A balance of skills, science, business and liberal arts, is most desirable for building collaborations in the future.

Prescribing a rigid structure which all collaborations must follow would be counter-productive for true innovation. We must drop the mindset that academia fulfills one role, industry another, and government provides the funding. Rather, researchers and policy-makers across sectors must move to fostering collaborations which entail dynamic partnerships between business, academic researchers and the government. Adding value to achieve true innovation is no longer best achieved through a push/pull dichotomy – it is done through constant collaboration.

BRINGING INNOVATION COLLABORATIONS TO THE HUMAN BRAIN

The Ontario Brain Institute

Don Stuss

The Ontario Brain Institute is a new initiative designed to help make Ontario a leading centre of brain innovation in the world. Utilizing unique research methodologies, such as common core platforms for each supported research project, OBI will be able to greatly expand the reach and impact of individual studies.

OBI also has unique internal structures which facilitate collaboration. In addition to requiring collaboration in every supported project, the Chairs of the OBI scientific and industry advisory committees sit on each other's committees, in order to ensure that there is open communication and collaboration to reach the Institutes research and commercialization objectives.

Ontario has established the goal of developing itself into a centre of excellence in brain research, and a global leader in brain innovation. All of the pieces are in place for Ontario to establish an international advantage in this area: the talent, the research capacity, the well-respected research approaches. But, the key to innovation in the brain, as with other fields, is collaboration. To foster cross-sector collaborations, new institutions such as the Ontario Brain Institute have been developed. As mentioned, the Institute has a resolute commitment to fostering collaboration in the work it supports, and has entrenched cross-sector collaborative mechanisms into its institutional structure. With its role as a catalyst for science, technology and collaboration, the OBI can serve as a guide for the innovations in the human brain which researchers in many fields across the province are aiming to achieve.



Brain Neurons: The Made in Canada Approach

Anthony Krantis

In the brain research field, one used to have to use neurons the moment they were harvested. But, new techniques pioneered at the University of Ottawa have made it possible to cryo-preserve neurons for use at any point in the future.

These off-the-shelf neurons allow for greater consistency in research, and provide a common platform for replicating results. The commercialization of this technology can serve as a model of effectively transferring an idea which was originally intended for academic purposes, to the market place. Approximately 65% of sales of the neurons are to industry.

Institutions like OBI foster the collaborations which are needed to realize the most out of new research, by generating the added value which transforms inventions into innovations. The on-the-ground implementation of these principles is key to success of Ontario's innovation economy. Individual researchers, be

The Virtual Brain

Randy McIntosh

The Virtual Brain works to pull data from multiple different sources in order to draw up a working model of how the brain functions – which is largely still a mystery. Advances in imaging technology have created vast amounts of data, which can now be interpreted by researchers from various fields (medical, engineering, physics) to work together to produce a virtual model that replicates the same dynamics as a human brain.

they in universities, private labs or with governments, each must maximize their resources to achieve the greatest added value – each researched is, after all, running their own small business. Obstacles do exist in this environment which hinder effective collaboration. Some argue that Canadian academics have an intrinsic bias against commercialization of their IP, while others argue that the institutions which are designed to facilitate commercial partnerships are ineffective, or that policy does not adequately

The Bilingual Brain

Ellen Bialystock

The structure and function of the brain are modified by ordinary experience. In the brain of bilingual individuals, the brain is in a constant state of conflict over which language to use. This requires the executive control centre of the brain to step in to assist in the decision making.

This strengthened executive control centre, it seems, has positive benefits in neurological diseases like Alzheimer's. Bilingual individuals show fewer cognitive deficits for the same biological progression of the disease than unilingual individuals. The ordinary experience of bilingualism modifies the structure of the brain in such a way that it can communicate better within itself, and thus shows fewer deficits when afflicted with Alzheimer's.

incentivize collaboration. Within the field of brain research, academic work which has gone on to achieve great commercial success, was helped by strong support within university management – a far different situation from the management resistance many researchers report facing. Other forthcoming innovations benefited greatly from the ability of industrial partners to accelerate the pace of the research.





PERSPECTIVE AND PARTNERSHIPS

Forging institutional collaborations, or supporting cross-sector partnerships, is a key goal of innovation policy and a prerequisite for Ontario's future successes in brain research. However, policy-makers and individual researchers must also recognize the need for individual projects to draw on a wide array of perspectives in order to achieve the greatest possible results. In order to innovate, different perspectives are required. Developing teams of innovators operating in an environment which supports risk-taking is an essential component in fostering successful partnerships.

In order to draw on the vast array of perspectives which may be necessary to realize fruitful partnerships, researchers in academia and industry must be ready to accept these different perspectives from the very start. Experiments must be designed to accept

Brain Research at IBM

Chad Peck

IBM is deeply involved in brain research. In fact, many argue that simulations, such as those conducted by IBM, are now the third pillar of brain research, along with experimentation and theory.

A prominent example of IBM's research into human thought is Watson, of Jeopardy! fame. Watson was developed by using a common platform among 200 researchers working at IBM on unstructured data problems. The ability of the machine to take in a question and develop reasonable suggestions as to the answer means it has future applications in fields such as healthcare and technical assistance.

Cognition and Innovation

Mel Goodale

At the University of Western Ontario, tremendous strides have been taken in the fields of cognitive neuroscience. Recent research includes work which may allow communication with individuals in a persistent vegetative state via examinations of the imaging patterns their brains produce when imagining different activities.

Other research includes studying the imaging patterns of individuals who, while being blind, have developed the ability to use echolocation. Recent work shows that in these individuals, the increased capacity needed to process auditory signals for echolocation comes from tissue appropriated by the brain from the otherwise out of use visual cortex.

integration of new ideas, and new data. When possible, experimental frameworks should be designed to be compatible and the data comparable, such as is required under the OBI. Projects must operate on collaborative methodologies, and in order to do so, must employ the most effective means of communication. While clearly academic and business researchers cannot accept perspective partnerships which take them outside of their strategic focus area, they must also be aware of the possibility of future collaborations in their work, and design accordingly.

To encourage these partnerships, we must modify what it is that we value about research and innovation. As previously noted, some in academia perceive a lack of institutional support for any collaboration with industry, and industry feels compelled to collaborate only when the project is strategically aligned, and the benefits outweigh the risks. In order to address these barriers to open collaboration,



we must move systemically to a new conception of what is valuable in our innovation system. If innovation is defined as adding value, then we must move to champion this as the ultimate goal of research. This is not merely about maximizing profits; it is about maximizing the impact of all potential research. It is no coincidence that the top researchers in the Natural Sciences and Engineering Research Council program for discovery-based research are also the ones who collaborate the most with industry. If Ontario is to become a global leader in brain innovation, we must learn to value innovation, and the partnerships which help generate it.

HOW TO CREATE THE CHANGE

Changing the culture and practice of innovation in order to foster a greater appreciation for cross-sector collaborations is not a simple task. It requires strategic guidance, and a shift in the

The Economics of a Healthy Brain

Adalsteinn Brown

There are tremendous direct and indirect costs associated with brain health. Neurological disease cost Canada over \$2 billion directly each year, but indirect costs are more severe. Neurological admissions to the emergency room are more likely to result in the need for complex continuing care. Informal caregivers (e.g. families) play a tremendous role. If their work was paid, these caregivers would earn over \$32 billion a year. Social trends will, in future, put increasing demands on the system for formal care, as people live longer, and the dependency ratio reverses.

way we approach new research. In key areas, like healthcare for neurological conditions, we are rapidly approaching the point where the system can no longer bear the burden we place on it. Holistic strategic reconsideration is needed, and government, academia and business must lead it together.

Brain Research at NSERC

Suzanne Fortier

As a country, we must raise our ambitions. We must aim to be discoverers and innovators at the top of our potential.

NSERC has 3 budget priority areas, one of which is Innovation – absorbing 30% of the Council's budget. Despite not being the top health council, NSERC has invested \$189 million in health research.

NSERC programs are becoming more geared towards collaboration, including the introduction of a program to pay for the first collaboration between researchers and industry, in order facilitate future partnerships.

In setting the goal of becoming a world-leader in brain innovation, Ontario has also recognized the need to create a strategy to achieve this goal. Unique new institutions such as the Ontario Brain Institute are a solid beginning, but cannot alone generate the change that is necessary. Ontario's brain innovation resources are vast – ranging from internationally recognized hospital networks, to top private sector research facilities, to individual researchers pursuing breakthroughs in university labs. All must be able to recognize the value of a strategic approach to innovation, and all must buy-in to the notion of collaboration as the source of success.





CONCLUSION

Frustration is a key driver of innovation. In Canada, we are no doubt experiencing frustration as we endeavor to improve our innovative capacity and increase our productivity and prosperity. During *Innovation and the Human Brain* it was clear that participants agreed on the importance of innovation. But, in a sense, innovation is the answer and what we really need to agree on is the question. In the field of brain innovation, the question is how do we become the best; how does Ontario become a leading global centre of excellence in the field? The overall goal is no doubt to improve the quality of the human condition and to add value to people's lives. A robust economic foundation, a strong social framework, health communities and individuals, and effective government policies all form the base upon which we can build the necessary innovation practice in Ontario.

However, having the basic elements is not enough. We must foster collaboration among all actors in the system in order to add the greatest value, and achieve the greatest innovation. Business, government and academic researchers in colleges and universities must collaborate early and often, and policy must incentivize and facilitate these collaborations. Research must draw on the broadest possible pool of perspectives, and collaborations must be constructed to multi-disciplinary, multi-sector and multi-national.

To foster these partnerships, we need innovation leadership from individuals and institutions. A strategy designed specifically to encourage the concerted action of all players is a necessity. We exist in an era of perpetual

change, and in order for everyone to be able to reap the benefits of innovation it must become a top of mind issue for the public, policy-makers and practitioners. All must recognize the need for innovation, and take the steps to achieve it.

As Minister Glen Murray noted during the conference's closing discussion, we are faced with increasingly broad societal challenges. Aging, for example, touches on any number of public policy areas, from urban planning, to housing to healthcare. With such multi-faceted problems, it is incumbent upon innovators and policy makers alike to break out of their silos and interact to generate creative and effective solutions. We must create shared value through the innovations we develop in Ontario, and take full advantage of the ideas which we are able to create.

To this end, the Minister noted that it is imperative that the research which should be translated to new business ideas is. It is necessary for Ontario to look internationally for the best partnership opportunities, while still recognizing that Ontario's own innovative capacity must grow, and be used to its full potential.

In the field of brain innovation, these notions resonate through new structures like the Ontario Brain Institute; new mechanisms of international collaboration, such as those lead by researchers at Baycrest's Rotman Research Institute; and new partnerships focused on shared value collaboration, such as those undertaken by IBM. To become a global centre of excellence in the field, we must build on these advances. In brain innovation, Ontario is on its way to top. With leadership and ingenuity in policy and research, there is true potential for great work to come.



APPENDIX 1: AGENDA



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INNOVATION AND THE HUMAN BRAIN

A Leadership Summit co-organized by IBM, the Public Policy Forum and Baycrest

Monday, May 16th, 2011

8:30 AM – 6:30 PM

IBM Canada Software Lab

Markham, ON

Agenda

- | | |
|---------------|---|
| 08:30 – 08:45 | Welcoming Remarks
<i>Dr. William Reichman, CEO, Baycrest</i>
<i>Don Aldridge, Industry Executive, IBM Canada</i>
<i>Paul Ledwell, Executive Vice President, Public Policy Forum</i> |
| 08:45 – 09:10 | The Role of Industry in Science
<i>Joseph Rotman</i> |
| 09:10 – 09:55 | Ontario Brain Institute – A Brief History and Future Directions
<i>Dr. Don Stuss, Ontario Brain Institute</i> |
| 10:25 – 11:05 | Brain Neurons – Made in Canada
<i>Dr. Anthony Krantis, University of Ottawa</i> |
| 11:05 – 12:00 | Innovation in Brain Research – A Conversation
<i>Dr. Randy McIntosh, Rotman-Baycrest and Dr. Mel Goodale, University of Western Ontario</i> |
| 13:20 – 14:05 | Brain Research at IBM
<i>Dr. Chad Peck, IBM Research</i> |
| 14:05 – 14:50 | The Bilingual Brain
<i>Dr. Ellen Bialystok, York University & Associate Scientist, Rotman</i> |
| 14:50 – 15:35 | The Economics of a Healthy Brain
<i>Dr. Adalsteinn Brown, University of Toronto</i> |
| 16:15 – 16:35 | Innovation in Ontario
<i>Hon. Glen Murray, Minister of Research and Innovation</i> |
| 16:35 – 17:20 | Brain Research at NSERC
<i>Dr. Suzanne Fortier, President, Natural Sciences and Engineering Research Council</i> |
| 17:20 – 18:30 | Reception |





APPENDIX 2: PARTICIPANTS

Don Aldridge
General Manager
Research and Life Science
IBM Canada

Mary Allen
IT in Canada

Cristiana Amza
Professor, Electrical and
Computer Engineering
University of Toronto

Ron Baecker
Professor
Computer Science-TAGlab
University of Toronto

Ellen Bialystok
York University
Associate Scientist, Rotman

Janet Boden
JB Writing & Design

Ania Bogacka
Longwoods Healthcare
Quarterly

David Bogart
Research Programs & Industry
Relations
Ontario Brain Institute

Adalsteinn Brown
Assistant Professor
Associate SGS Member
Chair, Public Health Policy
Dalla Lana School of Public
Health
University of Toronto

Grant Buckler
Globe and Mail

Barbara Burrowes
Director, Research Policy &
Government Relations
Research and Innovation
York University

Lynn Butler
Manager
Communications
Ontario Brain Institute

Ralph Chapman
Vice President, Federal Public
Sector
IBM Canada Ltd

Celina Chavannes
Project Coordinator
National Population Health
Study of Neurological
Conditions
Policy and Partnerships
Neurological Health Charities
Canada

Paul Chow
Professor, Electrical and
Computer Engineering
University of Toronto

Jenn Collins
Operations Manager
CAS Academic Partnerships
IBM Canada

John Connolly
Professor and Chair and Sir
William McMaster Chair in
Cognitive Neuroscience of
Language
Department of Linguistics and
Languages
McMaster University

Ryan Conway
Research Associate
Public Policy Forum

Hugh Couchman
Professor
Physics and Astronomy
McMaster University

Jeffrey Coull
Director, Operations and
Communications
Ontario Brain Institute

Fergus Craik
Senior Scientist
Rotman Research Institute

Amedeo D'Angiulli
Associate Professor
Neuroscience
Carleton University

Phil Dasilva
Client Executive
IBM Canada

Lino DeFacendis
Director, Commercialization and
Business Development
Innovations and Partnerships
Office
University of Toronto

Mark Foresi
External Relations
Alumni Relations and
Development
University of Western Ontario

Suzanne Fortier
President
Natural Sciences and
Engineering Research Council of
Canada

Dianne Foster Kent
Longwoods Healthcare
Quarterly



Robert Fripp
Impact Group

William Gage
Associate Professor
York University

Catherine Geci
Technology Transfer Manager
Business Development Office
University of Guelph

Randy Giffen
Cognos Healthcare Software
IBM Canada

John Goggin
Director, IBSG
Cisco

Lisa Goos
Director
Research Policy & Planning
Rotman Research Institute
Baycrest

Melvyn Goodale
Distinguished University
Professor, Canada Research
Chair in Visual Neuroscience,
Director, Centre for Brain and
Mind, Department of
Psychology
Centre for Brain and Mind
University of Western Ontario

Brian Gordon
Entrepreneur-in-Residence
Research
Baycrest

Chantal Graveline
Executive Director, Stakeholder
Development and Corporate
Planning
Geriatric Health Care System
Baycrest

Daniel Gruner
Chief Technical Officer Software
SciNet
University of Toronto

Ling Guan
Professor
Department of Electrical and
Computer Engineering
Ryerson University

Susan Harper
Client Executive
IBM Canada

Laurie Harrison
Vice-President, Corporate
Services & CFO
Baycrest

Stephen Hartlen
Assistant Vice-President and
Executive Director
Industry Relations
Dalhousie University

David Harvey
Chief, Public Policy and Program
Initiatives
Alzheimer Society of Ontario

Ted Hewitt
Vice-President, Research &
International Relations
University of Western Ontario

Pat Horgan
Vice-President Operations
Manufacturing & Development
IBM Canada

Jody Huber
Vice President
Appliance
Development/Workload
Optimized Systems
IBM Canada

Maria Huijbregts
Director, Clinical Performance
and Accreditation
Quality, Safety and Best Practice
Baycrest

Joe Irvine
Director, TTBE
Technology Transfer & Business
Enterprise
University of Ottawa

Stephen Johns
Researcher
Ryerson University

Eva Konstantellos
Client Executive
IBM Canada

Petar Kramaric
Research Associate
Ryerson University

Anthony Krantis
Director
Centre for Research in
Biopharmaceuticals and
Biotechnology
University of Ottawa

Colette Lacroix
Client Executive
Healthcare, Higher Education
and Research
IBM Canada

Janet LeClair
Chief Administrative Officer
York Regional Innovation Centre
ventureLAB

Paul Ledwell
Executive Vice President
Public Policy Forum

Peter Lewis
Associate Vice-President,
Research
University of Toronto





Joel Liederman
Vice-President, Business
Development and
Commercialization
Physical Sciences
MaRS Innovation

Veronika Litinski
Senior Advisor, Healthcare
Business Services
MaRS Discovery District

Chris Loken
Chief Technical Officer
SciNet
University of Toronto

Dan Lynch
Industry Liaison Officer
Innovation York
York University

Shannon MacDonald
Director
Policy and Partnerships
Neurological Health Charities
Canada

Nick Markettos
Assistant Vice-President,
Research Partnerships
McMaster University

Randy McIntosh
Director
Rotman Research Institute
Vice President of Research
Rotman-Baycrest

Graeme McKay
Vice President, Ontario
Government, Healthcare &
Higher Education
IBM Canada

Geoffrey Mealing
Senior Research Officer, Group
Leader
Neurobiology Program
National Research Council
Canada

Zul Merali
President and Chief Executive
Officer
Institute of Mental Health
Research
uOttawa Institute of Mental
Health Research

Paul Mercier
Manager, IT Operations
Computing and
Communications Services
University of Ottawa

Marcellus Mindel
Head of Academic Partnerships
Centre for Advanced Studies
IBM Canada

Jessica Morassutti
Conference Organizer
IBM Canada

Sylvain Moreno
Lead Scientist, Research
Centre for Brain Fitness
Baycrest

John Morton
Technical Director, SHARCNET
School of Computer Science
University of Guelph

Doug Munoz
PhD
Centre for Neuroscience Studies
Queen's University

Hon. Glen Murray
Minister of Research and
Innovation
Government of Ontario

Brian O'Higgins
President
Brian O'Higgins and Associates
Chris Paterson
Government Programs
Executive
IBM Canada

Chad Peck
IBM Research

Stephen Perelgut
Manager, University Relations
IBM Canada

Jim Peters
Entrepreneur-in-Residence
Research
Baycrest

Emil Petriu
Director
School of Information
Technology and Engineering
University of Ottawa

Dorina Petriu
Professor
Systems and Computer
Engineering
Carleton University

Leslie Plant
Media Relations
IBM Canada

Sheldon Polowin
Senior Labour Market Analyst
Information and
Communications Technology
Council



Hossein Rahnama
Associate Director
Digital Media Zone
Ryerson University

William Reichman
President and Chief Executive
Officer
Baycrest

Samantha Reid
Director
Business Development
MITACS Inc
Joseph Rotman

Danny Sands
Director, Internet Business
Solution Group
Cisco

Haridoss Sarma
Technology Transfer Manager
Business Development Office
University of Guelph

Stephen Scott
Centre for Neuroscience Studies
Queen's University

Stan Shapson
Vice-President Research and
Innovation
York University

Karlee Silver
Program Officer
Grand Challenges Canada

Pekka K. Sinervo
Senior Vice President, Research
Canadian Institute for Advanced
Research

Garth Smith
Industry Relations Manager
Ontario Brain Institute

John Soloninka
President and Chief Executive
Officer
HTX - The Health Technology
Exchange

Rosalind Stefanac
Pharmacy Practice

Bianca Stern
Director, Innovation, Arts and
Design
Culture, Arts and Innovation
Baycrest

Elissa Strome
Director, Strategic Initiatives
Office of the Vice-President
Research
University of Toronto

Don Stuss
President and Scientific Director
Ontario Brain Institute

Grant Tipler
Head, Life Sciences
Life Sciences and Health
Services Markets
RBC

Karima Velji
Vice President
Clinical and Residential
Programs
Baycrest

Alan Wassying
Director, McSCert
McMaster University

Michael Waterston
Program Manager
Centre for Brain Fitness
Baycrest

Nancy Webb
Vice-President
Strategic Advancement and
Stakeholder Relations
Baycrest

Pippa Wysong
Media

Hans Yu
Director
Health Canada

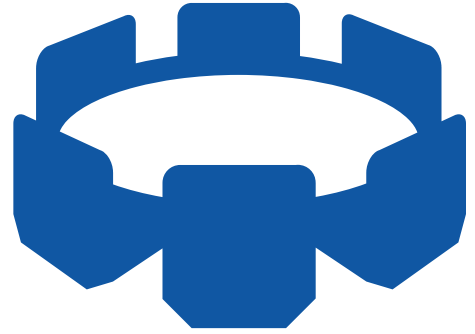




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Forum des politiques publiques

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