



UNIVERSITY OF TORONTO

Catalyzing Innovation: *Cities, Collaboration, Connections, and Commitment*

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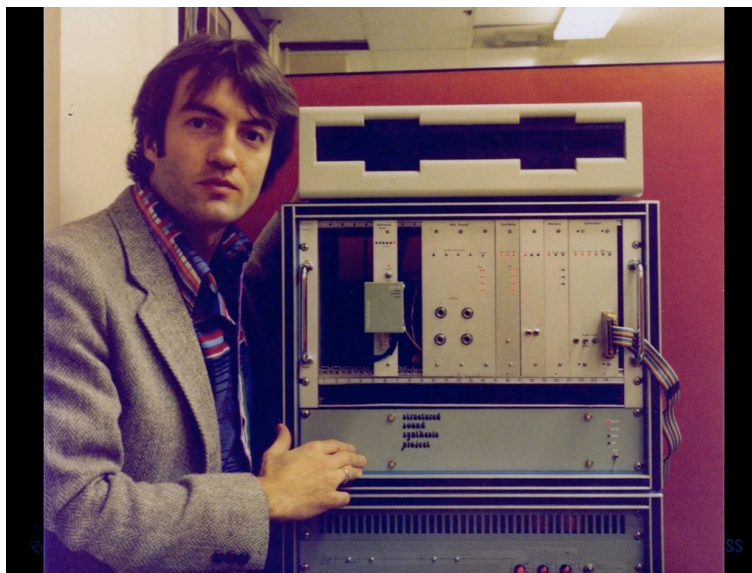
Thank you Dr. Treurnicht for your kind introduction. Thank you Minister Bains for your leadership and for your government’s leadership on behalf of all Canadians. It is a tremendous honour to join you today, and to welcome those of you visiting the University and the Toronto region from out of town.

This morning, I want to talk about what I will call the four ‘C’s: cities, collaboration, connections, and commitment. In particular, I want

to investigate how these four ‘C’s combine to foster innovation in our regions.

I have spent much of my academic career studying the economic geography of innovation and I would enjoy discussing this topic with you all morning. But I promise to keep my remarks today to just 20 minutes!

Let me begin with two brief stories to help illustrate the role that cities, collaboration, connections, and commitment play in driving innovation.



My first story takes us from electronic musical instruments to touch screens to the Academy Awards. And it starts with a man named Bill Buxton. Bill Buxton arrived at the University of Toronto with an undergraduate degree in music and graduated with an MSc in Computer Science in 1975.

He is pictured here with one of his early electronic instruments – you can tell from his clothes that this picture was taken in the 1970s.

Buxton joined the Computer Science faculty at U of T, and later became a Principal Scientist at Microsoft Research. In 2013, he received U of T’s highest recognition, an honorary degree.

In the intervening years, he and his colleagues in the University of Toronto’s Department of Computer Science pioneered extraordinary innovations in human-computer interaction.



Their work as far back as the 1980s led to the development of the multi-touch screens so ubiquitous today on all our smart phones and tablets.

In 1994, Buxton joined a firm in Toronto called Alias/Wavefront as Chief Scientist. Alias is now part of Autodesk, a firm headquartered in the San Francisco Bay Area. At Autodesk, Buxton helped lead a revolution in human-computer interfaces and digital graphics.

Autodesk was – and remains – a hotbed of innovation and entrepreneurial activity in Toronto, producing leading-edge software for 3D design, engineering, and entertainment – including their famous 3D rendering software Maya, which is used in many films.



- | | | | |
|------|--|--|------|
| 1997 | <i>Titanic</i> | | |
| 1998 | <i>What Dreams May Come</i> | <i>The Golden Compass</i> | 2007 |
| 1999 | <i>The Matrix</i> | <i>The Curious Case of Benjamin Button</i> | 2008 |
| 2000 | <i>Gladiator</i> | <i>Avatar</i> | 2009 |
| 2001 | <i>The Lord of the Rings: The Fellowship of the Ring</i> | <i>Inception</i> | 2010 |
| 2002 | <i>The Lord of the Rings: The Two Towers</i> | <i>Hugo</i> | 2011 |
| 2003 | <i>The Lord of the Rings: The Return of the King</i> | <i>Life of Pi</i> | 2012 |
| 2004 | <i>Spider-Man 2</i> | <i>Gravity</i> | 2013 |
| 2005 | <i>King Kong</i> | <i>Interstellar</i> | 2014 |
| 2006 | <i>Pirates of the Caribbean: Dead Man's Chest</i> | <i>Ex Machina</i> | 2015 |

Indeed, 2016 marked Autodesk's 9th Academy Award for Scientific and Technical Achievement and the 21st year *in a row* that the company's software was used in the movie that won the Oscar for Best Visual Effects! The winners are listed here on the slide.

Buxton's move to Alias now Autodesk signaled the start of a longstanding, close – symbiotic – partnership between the firm, U of T's Computer Science department, and the city of Toronto.

Over the years, Autodesk has hired hundreds of our graduates, some of whom later returned to our University as faculty members and serial entrepreneurs.

Today, Autodesk is dramatically increasing its investment in Toronto. The company is moving into two floors and a street-level space in the new West Tower of the MaRS Discovery District where we are gathered this morning.



One of their primary motivations is to be physically closer to the talent base at the University and in the city around us. Another motivation is to take advantage of – and contribute to – the highly creative innovation ecosystem that has emerged here in Toronto in recent years.

As one fascinating example of multidisciplinary innovation, Autodesk is partnering with MaRS Cleantech to give small, young clean / green tech companies access to Autodesk’s design and

visualization tools. This will enable these innovators to, in Autodesk’s description, “create digital prototypes, explore and communicate ideas, test multiple concepts and get to market faster.”

And the Autodesk story is just one facet of the exciting developments taking place here, thanks to the exceptional strengths of our Departments of Computer Science and Electrical and Computer Engineering – most notably in advanced computational fields such as artificial intelligence and machine learning. It all seems a long way from Buxton’s electronic musical instruments in the 1970s...

This remarkable story is an example of what happens at the intersection of the four ‘C’s: It is *fundamentally* a story about cities, collaboration, connections, and commitment. But before I make the point explicitly, let me tell my second story.



Ron Deibert joined the University of Toronto in 1999 and established the Citizen Lab in 2001. His background is in political science, and he was always interested in the various methods employed by state intelligence agencies: human spies, technological tools, legal and political instruments.

Deibert saw the dawning of the hyper-modern state intelligence industry and worried about its implications. Recall, this was a dozen years before Edward Snowden.

Deibert's goal in starting the Citizen Lab was to conduct multidisciplinary, evidence-based research into questions arising around human rights in digital space. From the very beginning, he realized that he would need to assemble an unusual team with very diverse skills, including human rights law, privacy and security policy, coding, and software development.

World University Rankings			
UNIVERSITY OF TORONTO	Overall	22	1
	Clinical, Pre-Clinical and Health	11	1
	Computer Science	11	1
	Arts and Humanities	14	1
	Life Sciences	17	1
	Law	19	1
	Social Sciences	19	1
	Physical Sciences	20	1
	Engineering and Technology	25	1

Times Higher Education, 2015; QS 2015

And the University of Toronto was the perfect place to establish it. He could draw on the University's deep and multidisciplinary strength, as you can see from the slide. Including: Canada's leading Department of Computer Science and Faculty of Applied Science and Engineering – to provide the technical know-how for the Lab's path-breaking work... A globally influential law school...

A leading Faculty of Arts and Science, including a world-renowned centre for international relations at the Munk School of Global Affairs... And, critically, an internationally respected research institution that offered freedom to pursue original and unorthodox ideas, in a highly livable, globally connected city.

Students, post-docs, and research fellows flocked to the Citizen Lab, motivated by a shared passion for human rights and cyber security. And before too long, their work was making headlines around the world.

Vast Spy System Loots Computers in 103 Countries

"The researchers, who are based at the Munk Center for International Studies at the University of Toronto, had been asked by the office of the Dalai Lama, the exiled Tibetan leader whom China regularly denounces, to examine its computers for signs of malicious software, or malware.

Their sleuthing opened a window into a broader operation that, in less than two years, has infiltrated at least 1,295 computers in 103 countries..."



On March 28, 2006, the front page of the *New York Times* read "Vast Spy System Loots Computers in 103 Countries". Researchers at the Citizen Lab had uncovered GhostNet, the largest cyber espionage network yet discovered. And the media attention was intense. Since then, the Citizen Lab's work has been featured on the cover of the *New York Times*, the *Washington Post*, or the *Globe and Mail* thirteen times.

And just three weeks ago, they were in the *Times* again for uncovering a major vulnerability in the iPhone that allowed hackers to spy on Ahmed Mansoor, an award-winning human rights activist from the United Arab Emirates.



"On the morning of August 10, Ahmed Mansoor, a 46-year-old human rights activist from the United Arab Emirates, received a strange text message from a number he did not recognize on his iPhone. ...

[He] didn't click on the link.

Instead, he sent the message to Bill Marczak, a researcher at Citizen Lab, a digital rights watchdog at the University of Toronto's Munk School of Global Affairs."

Motherboard, August 26, 2016

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The Citizen Lab worked with Apple, which promptly pushed out a patch to their operating system – to 800 million people. The report made headlines in virtually every media outlet, from *Aljazeera* to *The Atlantic*. It is staggering to think that research from the Citizen Lab directly affected more than 10% of the world's entire population over the course of just a few days.

Let me continue with the international theme for a moment. The Citizen Lab has partners and collaborators around the globe. They were founding partners in the Open Net Initiative with Harvard and Cambridge. Colleagues at Princeton and Berkeley are collaborating to create their own similar labs.

The Citizen Lab also has partners throughout the rest of the world, including: Argentina, Chile, Colombia and Costa Rica, along with research associates, students, and friends from across the Americas. Indeed, there is a vast global network of colleagues centred on Toronto.



Citizen Lab formal partnerships, 2016

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And in 2007, the Citizen Lab spun off a start-up company of its own. *Psiphon* employs 25 people at its head office here in Toronto. The company provides tools to evade web censorship to users whose access to the Internet is tightly controlled, filtered, or even denied. During the recent election in Iran, *Psiphon* served several million users a day from that country alone.

As with the Bill Buxton story I told a moment ago, Ron Deibert's story underlines the disruptive and

powerful forces at the intersection of the four 'C's, cities, collaboration, connections, and commitment.

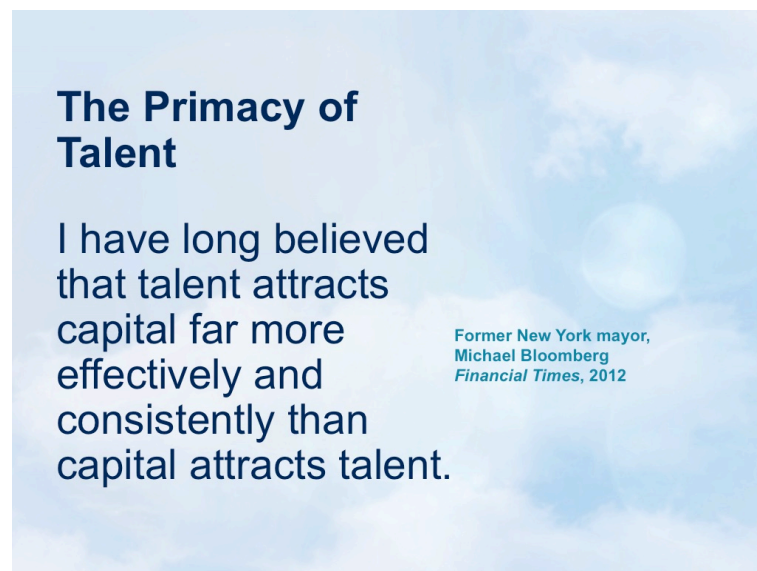
So let's now look behind the particularities of these two stories to draw out some larger lessons.

To do so, let me highlight the roles played by cities, collaboration, connections, and commitment in catalyzing innovation in our regions.

Start with *cities*.

Both the Bill Buxton story and the Citizen Lab story demonstrate the primacy of talent in driving innovation. Curiosity, creativity, know-how, and ingenuity are the foundations for innovation. That is why producing, attracting and retaining highly qualified talent has become a top priority for public policy aimed at enhancing a nation's innovative capacity. Human capital is the pre-eminent factor of production, shaping the competitive advantage of cities, regions and nations.

Of course, venture capital and other forms of finance are also important, but they are decidedly secondary. As former New York mayor, Michael Bloomberg, succinctly stated,



'I have long believed that talent attracts capital far more effectively and consistently than capital attracts talent.'

At the same time, it is important to recognize the virtuous circle at work here, and evident in both Autodesk's ability to recruit computer scientists and Citizen Lab's ability to assemble a multi-disciplinary research team.

Simply put, the most talented, creative, and entrepreneurial members of the labour force — those who generate opportunity and prosperity — prefer to live in urban settings that offer a high quality of place: cities that are culturally dynamic, physically appealing, that offer vibrant and safe neighbourhoods, good schools and hospitals, and that are open to newcomers and new ideas.

Universities and other research institutions contribute further to this dynamic, as both magnets for talent from around the world and local producers of talent.

Hence, the quality of a city's built form and transportation systems, its cultural scenes and amenities, its public facilities and parks are true pillars of economic prosperity and innovative dynamism, alongside its research and education infrastructure.

In discussing the role of Toronto in the Citizen Lab's success, Ron Deibert emphasizes the importance of its home in a diverse, vibrant, livable city, and, above all, access to the talented students and scholars who are drawn to this vibrant city-region. As for Autodesk, the livability and diverse talent base of Toronto (as well as San Francisco where it is headquartered) exerts a strong attractive pull.

But there is also another force at work here...

This observation brings me to my second 'C': *collaboration*.

Places like Toronto offer more than a high quality of life and a deep and diverse talent pool. They are also places that support collaboration, which leads to learning and knowledge sharing between economic actors.



Indeed, Jane Jacobs, a famous urban thinker who made Toronto her home for nearly 40 years, emphasized how cities generate 'knowledge spillovers' – both intentional and accidental. This ability to foster productive collaboration rests on three aspects of cities: first, critical mass or size; second, density of population and development; and third, diversity within the economic and talent base

According to Jacobs, these are the conditions that privilege urban

regions as centres of innovation. In such places, individual entrepreneurs can more easily join forces with others around them whose skills, experience and know-how complement their own. And their ability to find such complementary partners is enhanced when they are located in places that offer a large, dense, diverse pool of potential collaborators. Moreover, they benefit from accidental, serendipitous encounters with others who may bring new knowledge, perspectives, and networks to their attention.

These same conditions can also work on the demand side. A large body of empirical research has documented the importance of close interaction between innovators and their customers, who are often among their most important sources of innovative ideas.

Once again, our two stories demonstrate the importance of collaboration in supporting path-breaking innovation.

In the Buxton story, the close relationship that Autodesk enjoys with the Department of Computer Science at U of T is critical to its success. Indeed, when the original firm Alias/Wavefront was purchased by the foreign buyer, the new owner made a conscious decision to leave the acquired firm and its team in Toronto. This decision was motivated in large part by the close, collaborative relationship it enjoyed with our Computer Science department.

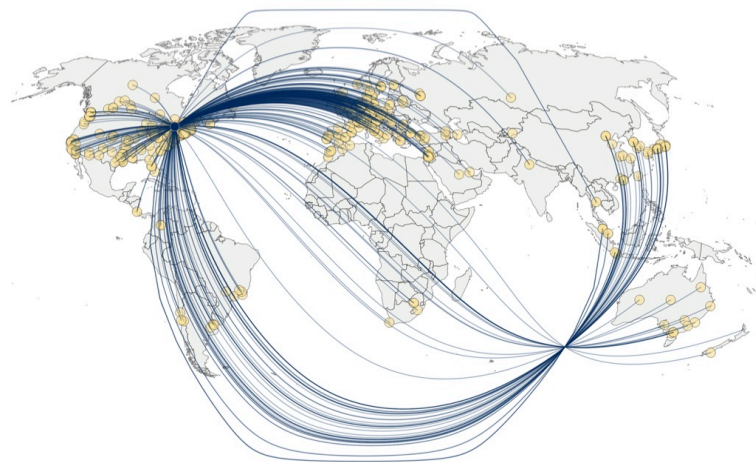
And more recently, the chance for Autodesk to work closely with emerging cleantech start-ups here in MaRS is another example of the power of collaboration to drive innovation.

As for the Citizen Lab, the foundations of its ultimate success rested upon Ron Deibert's ability to locate specialized programming expertise just a few blocks away from his research base at the Munk School of Global Affairs, in the same Computer Science department that spawned the likes of Bill Buxton.

Now onto my third 'C' – *connections*.

Innovative and entrepreneurial clusters are not just magnets for talent and places that produce and circulate knowledge through local collaboration. They are also highly connected to other leading centres of knowledge production, innovation and entrepreneurship around the world. They are major local nodes within global knowledge networks.

This is vital, since local and national innovation and prosperity depend on both locally produced knowledge, as well as knowledge produced in other global centres of research and innovation for their success.



The Citizen Lab's remarkable global collaborations, which I showed you a few minutes ago, exemplify this idea. Indeed, they take their place in U of T's vast global network of collaborations. In this sense, the University of Toronto – like all great research universities – is a gateway to the world for Toronto, Ontario, and Canada.

(This figure shows collaborations with scholars at the University of Toronto that produced at least 200 publications in the past five years.)

It is noteworthy that well-connected, globally networked centres of knowledge production are increasingly coming to the fore as the world's leading economic centres.

Venture capital and other forms of mobile investment now seek out these special places and the opportunities that are signaled by their world-leading research, their deep talent pool, and their connections to other global centres of knowledge production and innovation.



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Once again, the Autodesk story is a case in point, as their recent investment at MaRS is driven in part by their ability to tap into the global networks in which U of T scholars are deeply embedded.

As an aside, the Autodesk investment in the MaRS centre is just one of the reasons why there is such a fantastic buzz around this place. You'll be hearing more about the other very exciting developments happening here in

biomedical innovation this afternoon when you visit JLABS, which is Johnson & Johnson Innovation's first accelerator established outside the United States.

Of course, local buzz, collaboration and global connections by themselves are important, but there's at least one more theme to emphasize. And that's my fourth 'C': *commitment*.

Innovation does not happen overnight. Commitment is often the highest hurdle in modern democracies whose leaders must regularly face anxious, impatient electorates with high expectations and short-term time horizons.

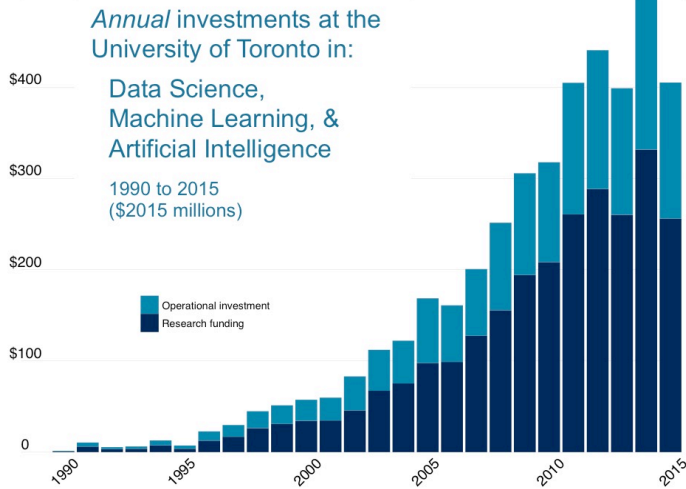
But success *requires* commitment, along with sustained investments, as well as a tolerance for risk-taking and failure, as part of an overall strategy. This strategy must recognize and leverage those unique competitive advantages that are increasingly clustered in a relatively small number of urban regions. Undeniably, such commitment takes political courage, a fifth 'C' perhaps.

Both the Bill Buxton and Citizen Lab stories are examples of this kind of courage and commitment.

The path that took Buxton from electronic musical instruments to multi-touch displays to the Academy Awards and beyond took genius – but also decades of work, a number of wrong turns, and sustained support. Autodesk's commitment to nurturing the relationship with U of T over the long haul has also been key to their current success.

The Citizen Lab has evolved over a dozen years from a single person to a global network of partners hosted at the University of Toronto – one of a handful of places with the academic depth, breadth, and freedom to nurture such an original and often controversial idea.

Commitment



As the Bill Buxton and Citizen Lab stories illustrate, the four ‘C’s combine to foster innovation in powerful, disruptive, and unpredictable ways.

Thank you for your kind attention.

And both cases rely for their success, at least in part, on the cumulative investments in research capacity in fields like computing and data science made by our federal and provincial governments, and by the host institution itself.

Let me conclude. Success in innovation is obviously the product of many factors. But I hope I have persuaded you that among those factors the four ‘C’s – cities, collaboration, connections, and commitment – play an outsized role.