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University of Waterloo Economic Impact Assessment

November 2019

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Forward by Craig Alexander, Chief Economist, Deloitte Canada

Universities play a critical role in educating students and contributing to knowledge and research. Today, these activities are occurring during a period that the Canadian economy and society are rapidly evolving. On the economic front, traditional manufacturing and commodity sectors are declining as a share of economic activity. Canada's economic growth is increasingly coming from information and technology, advanced manufacturing and services. These trends reflect the impact of globalization and the digital revolution that is changing the skills demanded by employers and disrupting labour markets. Meanwhile, society is changing. Aging demographics mean that Canada is becoming more reliant on immigration, leading to greater diversity in the population and workforce. Canada's ongoing commitment to multiculturalism is increasingly one of its strengths, particularly given that many other countries are becoming less receptive to newcomers. In this background, the role of universities in the economy and society has become more important than ever.

Deloitte has been retained to do an Economic Contributions Study for the University of Waterloo ('the University'). Not surprisingly, the University contributes significantly to economic activity, employs thousands of professionals and contributes to the public purse through taxes that are reinvested in the community. What the dry economic numbers mask is the unique contributions that the University of Waterloo is making to the economic and social development of our country that are critical to economic competitiveness. Let's look at three key dimensions.

First, the University is successfully contributing to innovation and entrepreneurship. This is a critical issue for Canadian economic competitiveness. Indeed, Deloitte created a Competitiveness Scorecard for the Business Council of Canada that identified weak innovation outcomes as one of the top three competitiveness challenges for our economy. The University has been ranked as Canada's most innovative university for the last 27 years and Canada's #1 comprehensive research university for the past 11 years.

In the classroom, an emphasis on real world applications helps to foster business acumen and entrepreneurship and helps support students to identify ways to adopt technologies in their professional lives. The University also has a sophisticated incubator and accelerator ecosystem oriented to launching and scaling new endeavors that is enhanced by the support of alumni entrepreneurs that give back to students. This background creates an environment that can promote and reinforce entrepreneurial activity and the generation of new businesses in the economy - a key component of economic growth.

Second, the University is helping to build a resilient workforce of the future and helping youth overcome barriers to entry into the labour market by giving them real world experience. Core to the mandate of the University is to advance learning and knowledge through teaching, research, and scholarship. Traditionally, this has been done solely in the classroom. However, there has been some public debate about whether post-secondary education institutions are adequately delivering work-ready employees. Additionally, businesses have a strong preference for hiring those with work experience. This calls for a greater emphasis on experiential learning, an area the University's Co-operative Education Program has excelled at for many years.

Third, the University makes impacts in its community. As a leading education and research centre, it attracts people from all walks of life to the region. This adds to the diversity of the regional population. Importantly, if international students opt to stay in Canada after graduation, the University is helping to address demographic pressures and is contributing to multiculturalism - a vital part of the region's social fabric.

Our main conclusion is that the University of Waterloo is helping to build a prosperous Canada in long-lasting, multifaceted ways that go beyond the classroom and can be framed as supporting Canadian economic competitiveness.

A handwritten signature in cursive script, appearing to read "C. H. Alexander".

Craig Alexander

Chief Economist at Deloitte Canada

1. Executive Summary

Deloitte has been retained by the University of Waterloo to characterize and estimate the University's significant annual economic contributions. It performs well in different university rankings. For instance, the University has been ranked 6th in the world for telecommunications, 22nd in the world of computer science and is one of the world's top 100 universities for environmental studies¹. The University has also been ranked as Canada's most innovative university for the last 27 years running, according to a reputation survey from MacLean's Magazine².

The role of a university in the economy is widely predicated on its role as a place where the next generation of the workforce learn skills. Our analysis reveals that the University of Waterloo's economic contributions extend beyond this classical role and can be characterized and/or estimated in the following dimensions:



1. The University's role as a significant employer in the region and the economic contributions of the spending on operations, and infrastructure



2. The notable economic contributions of the University of Waterloo Co-operative (Co-op or the Program') Education Program



3. The University's strength in supporting entrepreneurship



4. The economic contributions of the University's research activities



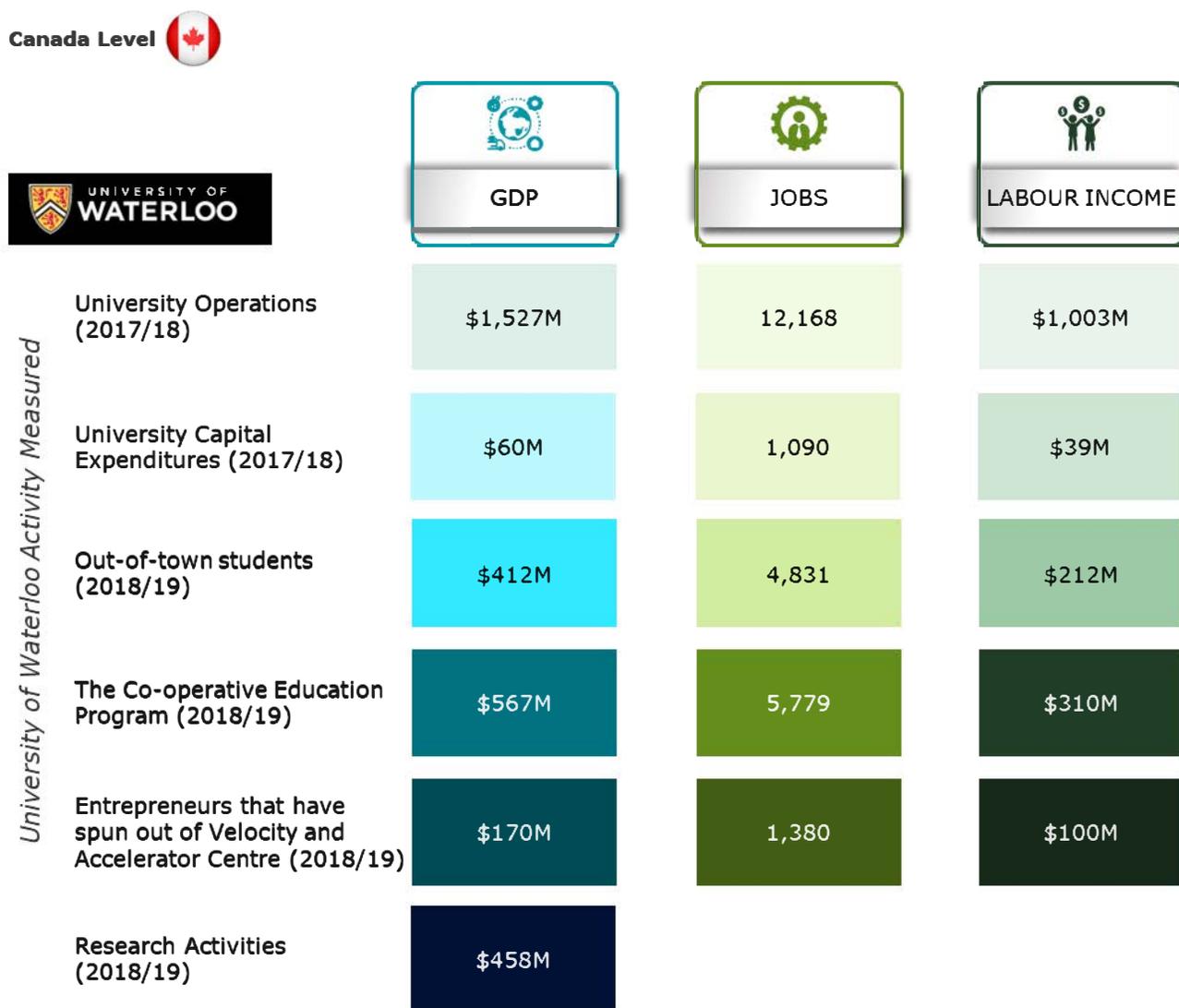
5. The University's contributions as a pillar of the Waterloo region community

¹ University of Waterloo. 2019. University of Waterloo rankings and reputation. Web Source: <https://uwaterloo.ca/future-students/university-of-waterloo-ranking>

² Most Innovative University, 27 Years Running. Web Source: <https://uwaterloo.ca/computing-financial-management/news/most-innovative-university-27-years-running>

Given the multidimensionality of the University’s economic contributions, Deloitte undertook several forms of analysis including consultations with business, university, research, entrepreneurship, and government stakeholders. Deloitte also reviewed secondary research and rankings to further describe the University’s contributions to the economy. Some of the University’s economic contributions have been quantitatively estimated and can be summarized as follows:

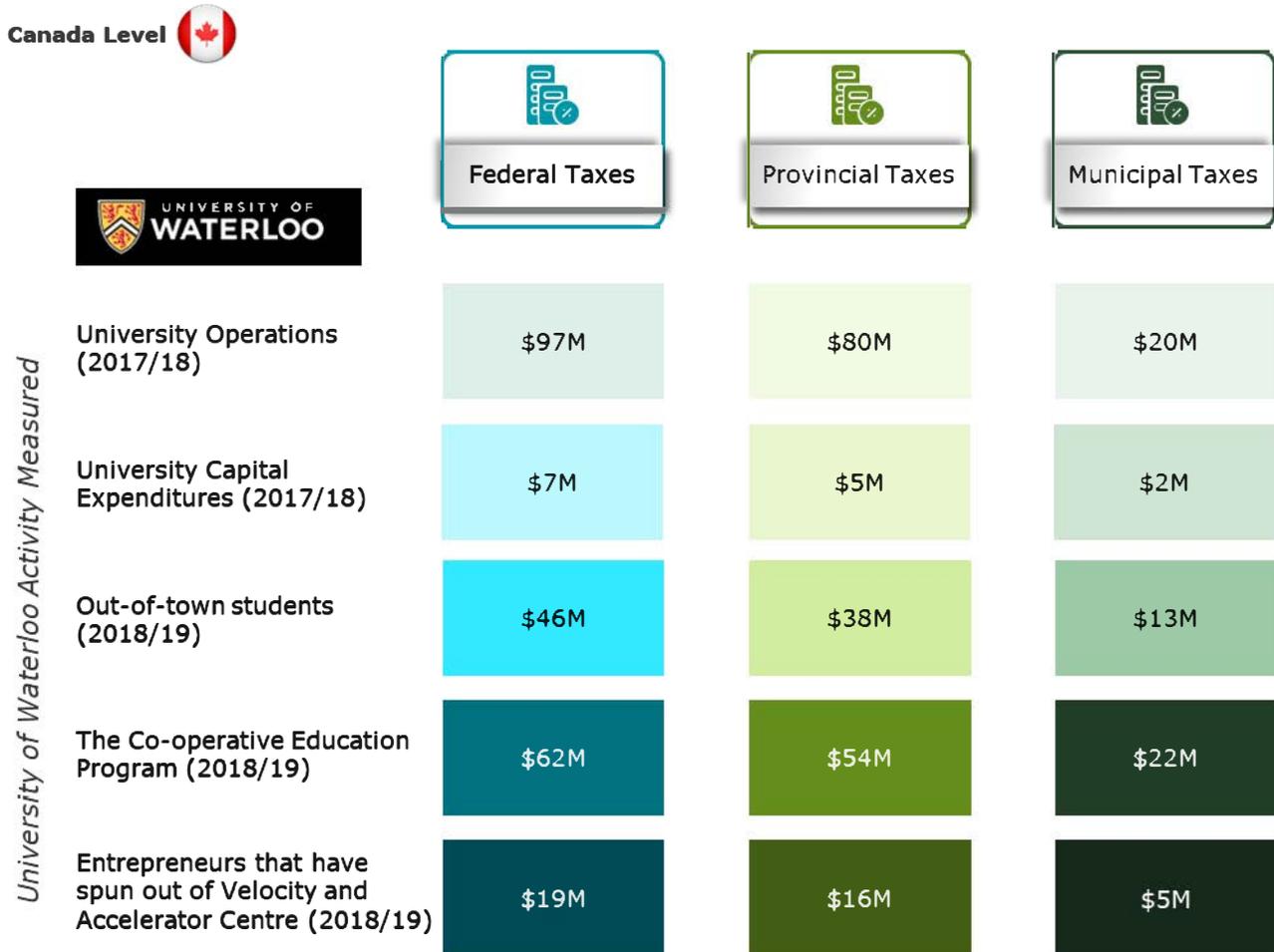
Figure 1: Breakdown of the University of Waterloo’s Annual Economic Contributions in the analyzed dimensions



Results cannot be added as they measure distinct activities over different time frames. For a detailed breakdown of national, provincial and regional economic contributions for each activity please see the report. The economic contribution shown are a total, a sum of direct, indirect and induced economic contributions.

³ Our analysis estimates the economic contributions of research expenditures incurred between 2014/15-2018/19 in the year 2018/19 only. Therefore the impacts presented are the impacts for 2018/19.

Figure 2: Breakdown of the University of Waterloo’s Annual Direct, Indirect and Induced Government Revenue Contributions



Results cannot be added as they measure distinct activities over different time frames. For a detailed breakdown of national, provincial and regional economic contributions for each activity please see the report. The economic contribution shown are a total, a sum of direct, indirect and induced economic contributions.

To provide more context on these quantified estimations, our analysis revealed the following mechanisms where the University is able to support the local, provincial and national economies:



1. The University’s role as a significant employer in the region and the economic contributions of the spending on operations, and infrastructure

The University is a major employer within the region: The University has 3,926 full-time employees and 183 part-time employees. In 2017, the University of Waterloo ranked 3rd largest in terms of number of full-time faculty members among Ontario’s six most research intensive group of universities.⁴

Annual operations trigger further economic contributions: Operational expenditures contribute to a majority of the economic contributions of the University that were estimated – demonstrating that the University’s presence in

⁴ CUDO. 2017. Number of Instructional Faculty Members (Excluding Clinicians) in Each Category.

the region is a significant asset to the community. The impact of operational expenditures is particularly large to the regional economy given that the majority of operational expenditures are for University payroll. As a result, wages and salaries paid out by the University are assumed to be spent within the local economy thereby generating sales for local businesses. We assume that local businesses could also allocate a portion of sales towards wages and salaries which are again circulated through the economy.

Attraction of new, out-of-town spending into the region: The University is also able to act as a magnet and attract students into the region. In 2018/19, 86 percent of the student body was from outside of the Waterloo region. These students live and spend within the economy and can be a key source of income for local businesses.



2. The notable economic contributions of the University of Waterloo Co-operative Education Program

Ensuring students' skills, perspectives and experiences set them up for success in the labour market is vital to Canada's economic prosperity. The University has excelled in this regard, fueled by the Co-operative education program where 120 accredited Co-op programs exist with over 7,000 employers that offer work terms in over 60 countries⁵. The Co-op program can be seen as a 'win-win' for all involved.

Employers realize a range of benefits from participating in the program: The program is viewed as a key funnel of future talent, and a source for new ideas across disciplines to solve real world challenges. Employers also recognize quantifiable gains that have been estimated as follows:



Part of the excellence of the program is the fact that it is able to drive impacts for employers and student participants simultaneously. **Co-op students realize lasting career and financial benefits including:**

- Ability to command higher wages compared to peers
- Enhancing long-term financial outcomes (e.g. ability to pay down student debts)
- Developing a professional network earlier in life
- Successful transition into full-time employment

It is worth noting that a tax linkage study involving the University of Waterloo and other Canadian Universities indicated that the University of Waterloo's graduates (across all program streams, including co-op students) can command higher wages than peers⁶. The study found that Waterloo graduates could earn 16% more five years after graduation compared to the average for all other participating Canadian universities. The study also indicated that graduates of co-op programs experience a significant sustained earnings premium over time relative to graduates of regular programs.⁷ Higher wage levels can reflect the value employers place on the quality of skills and capabilities of workers coming from the University of Waterloo.

⁵ University of Waterloo. 2019. About Co-op. Web source: <https://uwaterloo.ca/co-operative-education/about-co-op>

⁶ The study referred to here was conducted by the University of Waterloo

⁷ University of Waterloo. Earnings of Post-Secondary Graduates – A Tax Linkage Approach.



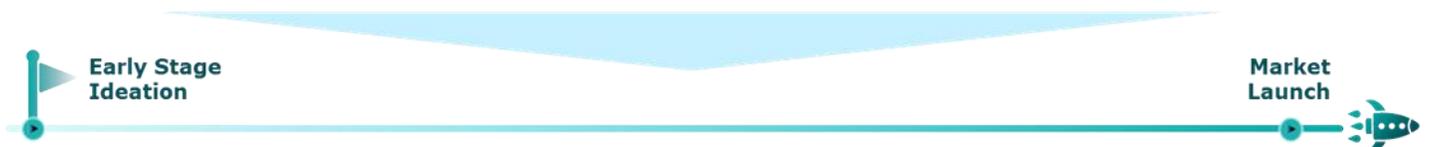
3. The University's strength in supporting entrepreneurship

Another dimension of the University's space in the economy is its ability to support innovation and entrepreneurship through the following mechanisms:

Embedding entrepreneurship in teaching: In the classroom, students at the University of Waterloo are challenged with thinking through the real world applications of the content taught in the classroom using interdisciplinary approaches that connect theoretical training to the practical challenges faced in society.

Leveraging the university's alumni community to support the next generation of entrepreneurs: Stakeholders pointed to the culture of alumni giving back to the University as its 'secret weapon' in supporting entrepreneurs. Alumni give back to student entrepreneurs through participating in mentorship programs, and informal events (e.g. Hackathons etc.) where current students can benefit from the insights and direction of graduates. In consultation with alumni of the University, graduates expressed a deep sense of pride and community which can lead to meaningful, tangible support for the next generation of entrepreneurs.

The University's incubator and accelerator ecosystem: The University supports entrepreneurship through a suite of organizations specifically dedicated to providing training, coaching and resources throughout all stages of the commercialization process from the early stages of inspiration and discovery, to the incubation and acceleration of commercial ventures.



The University's ability to support entrepreneurship can also be seen through the ability of alumni-founded companies to access venture capital (VC). For entrepreneurs, accessing venture capital can be a significant milestone. VC investment provides firms with capital, strategic assistance, and introductions to potential customers, partners, and employees.

There is evidence that the University of Waterloo founders have been able to access this important milestone.



- **University of Waterloo produces the largest number of VC backed entrepreneurs in Canada:** In 2018/19, Pitchbook ranked the University of Waterloo 21st in the world in terms of the number of VC-backed entrepreneurs and 1st amongst Canadian peers.



- **University of Waterloo surpasses other Canadian universities in terms of amount of VC raised by alumni:** Pitchbook has identified at least 408 entrepreneurs and 314 companies that were founded by University of Waterloo graduates over the 2006-2018 period. These spin-offs were identified to have raised \$7.36 billion in North American VC over this period.

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4. The economic contributions of the University's research activities

A home for world-class researchers and institutions: The University is renowned for its research excellence. This reputation is exemplified in the 74 Canada Research Chairs, two Canada 150 Research Chairs and two Canada Excellence Research Chairs. The University is home to over 30 dedicated research institutes that advance leading research such as the Institute of Quantum Computing – focused on using quantum laws to develop new technologies and an anchor for Canada's 'Quantum Valley'⁹.

Support for research partnership: The University is able to leverage the resources and support of partners to achieve shared research goals. The University is an active participant in international, pan-Canadian and interdisciplinary research partnerships that create forums through which shared research goals can be achieved. The University partners with corporations, peer institutions and governments to work together to solve some of the world's most complex problems. For example, the National Research Council of Canada (NRC) Collaboration for Artificial Intelligence, Internet of Things, and Cybersecurity was established in 2019 as a partnership between the University of Waterloo and the NRC to advance intelligent logistics research.

Economic contributions of research expenditures: The University of Waterloo continuously invests in research activities. These activities can drive economic growth as they can support technological advancement, ultimately leading to increase in productivity. To estimate this dimension of the University's contributions to the economy, we have estimated the economic contributions of University research activities in 2018/19 undertaken between 2014/15 and 2018/19. We used a dynamic approach to measure the economic contributions of research expenditures by taking into account spillover impacts of knowledge created by a university on labour and capital productivity. The results of our analysis are summarized below:



It can be noted that our analysis may underestimate the total contribution of research expenditures given that we present a point-in-time estimate and look at contributions to Ontario's GDP in 2018/19 from research undertaken in the previous five years only. Ongoing citations of research published by the University prior to 2014-15 as well as

⁸ PitchBook. 2019. PitchBook Universities: 2018-2019 Edition. Web Source: https://pitchbook.com/news/reports/2018-pitchbook-universities-2018-2019-edition?utm_medium=nl-na&utm_source=reports&utm_campaign=2018-2019-universities

⁹ McLeod, J. 2019. Waterloo aims to be the world's Quantum valley with help from government funding. *Financial Post*. Web Source: <https://business.financialpost.com/technology/new-funding-adds-fuel-to-waterloos-quantum-computing-dreams>

ongoing cumulative advancement of research and technology commercialized prior to 2014/15 could drive additional and different economic contributions not captured herein.



5. The University's contributions as a pillar of the Waterloo region community

Economic contributions are only one frame of the University of Waterloo's impact. Universities are uniquely positioned to provide certain services to society thanks to the financial and human capital resources they have access to. The University of Waterloo, however, can be viewed as an engine of the Region of Waterloo which has directly shaped the character of living and working in the region through the following frames:

- Attracting people from around the world to Waterloo region
- Supporting positive policy outcomes
- Supporting arts and culture
- Championing diversity and inclusion
- Partnering to achieve shared economic development goals
- Building the community through volunteerism
- Educating the next generation

2. An Introduction to the University of Waterloo and its Economic Contributions

2.1. Report background and purpose

The role of universities in shaping Canada's economic competitiveness and the quality of life for communities across the country has dramatically expanded in recent years. At their core, universities are essential to the Canadian economy. The role of universities in the economy has traditionally been framed simply on its contributions to human capital, a significant component of Gross Domestic Product (GDP). A University education provides skills and knowledge to graduates that they can leverage for higher incomes (when compared to non-graduates) in the labour force.

In turn, university graduates spend within their communities providing businesses customers, and enhancing activity in the economy. Further, universities are key supply sources of talent for employers. Over time, the needs of employers help to shape curricula contributing to a positive feedback loop in which universities can be viewed as an engine of the labour force.

The University of Waterloo ('the University') however, extends its contributions and importance to the Canadian economy to surpass these classical mechanisms. The University of Waterloo plays a significant role in the Canadian economy and has made choices that go beyond teaching students. Chief among these differentiated features is the University's active role as a bridge between the Canadian academic and business communities through the execution of the world's largest Co-operative Education Program ('Co-op' and/or 'Co-op program')¹⁰. In addition, the University has also deliberately prioritized supporting entrepreneurship as part of its ethos. These efforts have paid off, with several examples of alumni becoming leaders in their industries and starting globally leading companies in Canada. The University has also invested in its specialized research capacities – positioning it as a global leader in ground breaking fields of discovery that enhance Canada's innovation competitiveness. Importantly, the University is more than a post-secondary institution and is an active civic and community partner in the Waterloo region that has led to the region as being a highly desirable place to live and work.

While expansive, some of these impacts can be quantified and described through real world examples. Accordingly, the University of Waterloo retained Deloitte LLP to characterize and estimate the economic contributions of the University to the Waterloo region, Ontario and Canadian economies, and to characterize selected socio-economic benefits the University is able to drive.

2.2. About the University of Waterloo

Canada's universities are sophisticated and globally competitive. Canada boasts some of the highest post-secondary graduation rates in the world¹¹. Established in 1957,¹² the University of Waterloo has grown into one of Canada's leading educational institutions with a total of 32,644 full-time undergraduate students, 4,728 full-time graduate students (Fall 2018),¹³ and 1,260 faculty¹⁴. The University has a truly regional presence with its main campus located in the City of Waterloo, and an additional three satellite campuses in the surrounding communities of Cambridge, Kitchener and Stratford which each contribute to the fabric of their communities.

¹⁰ Ontario's Universities. The world's largest co-op program. Web source: <https://ontariosuniversities.ca/stories/the-worlds-largest-co-op-program>

¹¹ OECD. 2018

¹² University of Waterloo. 2019. About Waterloo. Web source: <https://uwaterloo.ca/about/who-we-are/history>

¹³ University of Waterloo. 2019. Student Headcount. Web source: <https://uwaterloo.ca/institutional-analysis-planning/university-data-and-statistics/student-data/student-headcounts>

¹⁴ University of Waterloo Statistics. 2019

A key dimension of the University's contribution to the Canadian economy is its ability to attract and retain talent from around the world such as globally leading students, experts and researchers to Canada. In 2018, the University graduated 8,652 students and is home to 1,260 faculty members. In 2018/19, 86 percent of the student body was from outside of the Waterloo region.¹⁵ Approximately 20 percent of students enrolled are international students (Fall 2018),¹⁶ coming from 120 countries¹⁷.

The University attracts significant funding for research excellence, which serves to attract and retain global talent to the University. In 2018-19, the University had \$258.3 million in sponsored research, funding by the Tri-Council, the provincial and federal governments, industry and other partners.



Students gathering at the SLC

The University is also ranked second in Ontario for disbursing scholarships and bursaries, funding \$107 million to students in 2017. The University's ability to attract talent from across the country and around the world is a key building block of Canadian economic competitiveness. The global talent race will persist, with countries and businesses competing for the best and brightest.

Importantly, the University has prioritized teaching and research approaches that set students up for success in the workforce and meet the evolving requirements of Canadian employers. In the coming years, jobs can be expected to demand a unique combination of skills and ability to help humans interact with, and support, machine-powered and data-driven approaches to solving problems. Skills such as problem-solving, communication, interpretation and design can be expected to be in demand in the future and require new approaches to teaching.

The University was ahead of the curve and has responded to this challenge through its Co-op program which embeds workplace experience into degree programs as well as the development of new degree programs designed to equip students with cross-functional skills that will be relevant today and tomorrow.

A critical dimension to the University's approach to teaching is aligning teaching to the needs of the Canadian economy. It is worth noting that a tax linkage study involving the University of Waterloo and other Canadian Universities indicated that the University of Waterloo's graduates (across all program streams, including co-op students) can command higher wages than peers. The study found that Waterloo graduates could earn 16% more five years after graduation compared to the average for all other participating Canadian universities.¹⁸ The study also indicated that graduates of co-op programs experience a significant sustained earnings premium over time relative to graduates of regular programs. Higher wage levels can reflect the value employers place on the quality of skills and capabilities of workers coming from the University of Waterloo. Importantly, for University of Waterloo graduates who are able to command higher wages, these benefits can accrue and grow over the length of their career.¹⁹

2.3. Analytical approach

Given the University's breadth of interactions with the economy, Deloitte utilized a holistic approach to assessing the University's range of contributions in the Waterloo region, Ontario and Canada by examining five dimensions of annual economic contributions as follows:

¹⁵ University of Waterloo Statistics. 2019.

¹⁶ University of Waterloo Statistics. 2019.

¹⁷ University of Waterloo. 2019. International Students Admission. Web source: <https://uwaterloo.ca/future-students/international-students>

¹⁸ University of Waterloo. Earnings of Post-Secondary Graduates – A Tax Linkage Approach.

¹⁹ While the tax linkage study demonstrates that University graduates can have an earning premium relative to students from other Canadian universities, the contribution of increased earnings for the University's graduates is only qualitatively described. There is insufficient data on a range of personal, regional and job related characteristics that can influence the earnings of an individual (e.g. age, gender, marital status etc.). This lack of data prevents us from isolating the true extent to which the completion of a University of Waterloo degree program result in higher wages post-graduation.

- Examining the University’s role as a significant employer in the region and the economic contributions of the spending on operations, and infrastructure;
- The notable economic contributions of the University of Waterloo Co-op Program;
- The University’s ability to support entrepreneurship;
- The University’s research activities; and
- The University’s contributions as a pillar of the Waterloo region community

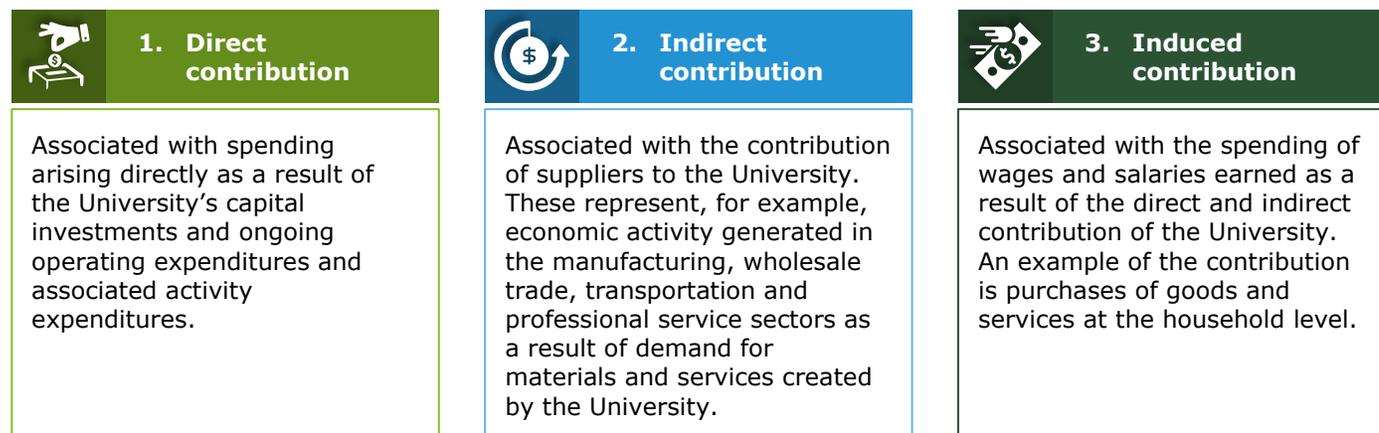
Each of these dimensions is complex, and drives specific benefits to the economy which can be assessed using different approaches. To measure the aforementioned frames of economic contribution, Deloitte blended qualitative and quantitative methodologies. To understand what makes the University unique we executed consultations with community, business, university, employers, and research and government leaders. Current students and alumni were also interviewed to further understand how the University is able to drive economic impacts. Selected secondary literature was also examined to demonstrate the economic benefits associated with the University’s activities. Where possible, relevant data that benchmarks the University against U15 or Ontario’s six most research-intensive universities peers was also included to contextualize the University’s achievements.

In addition, five frames of economic contribution were estimated quantitatively to further characterize the University’s economic contributions. It can be noted that in order to provide an up-to-date analysis of the University’s impact, Deloitte utilized the most recently available data where possible. As a result, given that we are using different years of reference it is important to note that economic contribution figures cannot be added. A summary of the different levels of contributions measured are provided below:

- The economic contributions of the University’s spending on operations, and infrastructure in 2017/18²⁰ (e.g., salaries and benefits, computer hardware purchases, utilities);
- The economic contributions of the University’s student expenditures in 2018/19 (inclusive of spending from out-of-town students);
- The quantifiable gains for companies that participate in the University’s Co-op program as employers in 2018/19;
- The economic contributions of companies that participated in programs at the University of Waterloo’s Velocity Center and Accelerator Centre in 2018/19; and
- The economic contributions of the University’s research expenditures in 2018/19.

These dimensions were estimated using tailored “input-output” methodologies which are able to trace how the expenditures associated with the University’s operations and associated activity ripples through the region’s economy by creating demand for goods and services across industries.

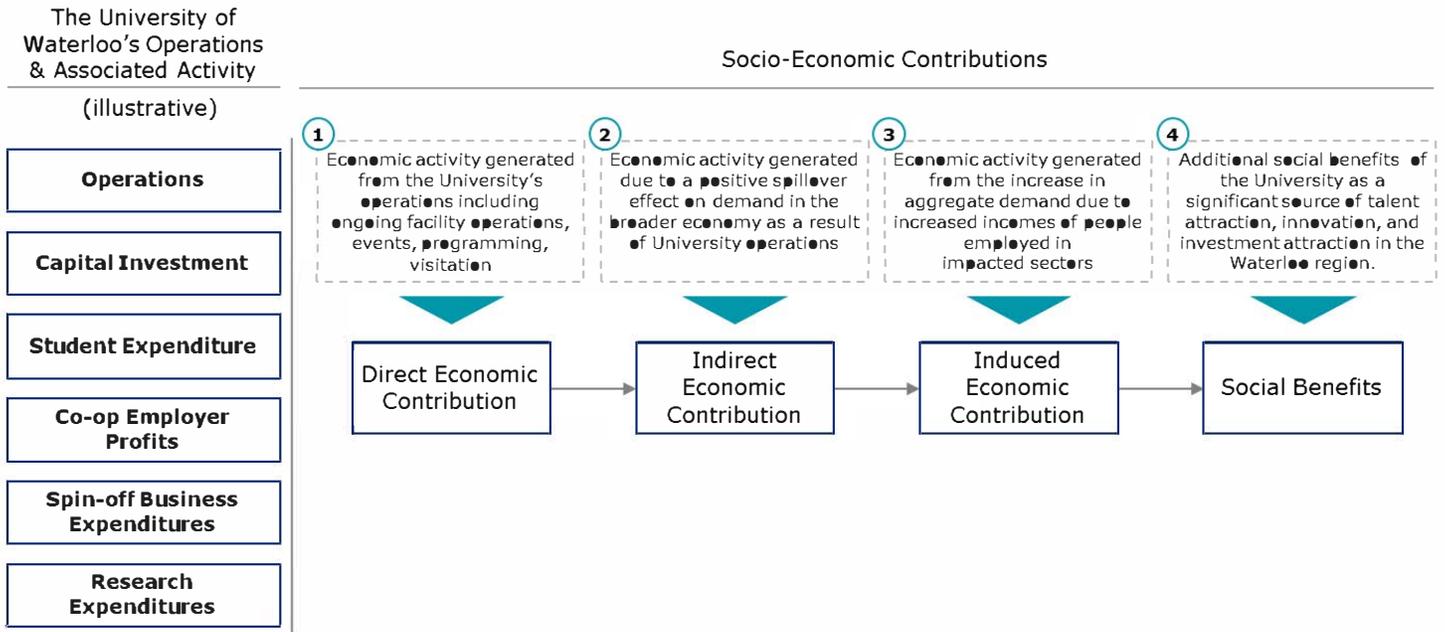
The University’s economic contribution is estimated at three levels:



²⁰ At the time this study was completed, the University’s 2018/19 capital and operating expenditure data was unavailable.

These levels of contribution are illustrated below:

Figure 3: Breakdown of the University of Waterloo’s Economic Contributions



Universities can influence the economy in several ways. Accordingly, economic contribution estimation analysis can be conducted using a wide variety of inputs. In each of the dimensions quantitatively estimated, analysis was conducted on selected dataset(s) that contained relevant inputs to the input-output models that could be attributed in a meaningful way to the University that were up-to-date, comprehensive and discrete (e.g. did not double count across a specific variable). In some instances, our methodologies rely on assumptions that may influence the magnitude of economic contribution estimates. For further information on the methodologies undertaken herein, please see the Appendices.

2.4. Regional analysis methodology

The estimations of the University’s economic contributions are multidimensional, and extend from the local Waterloo community to the national level. To capture this nuance, our analysis segments the economic contribution estimates of the university’s operations and associated activity at three regional levels:

- Waterloo region²¹ (local area)
- Ontario
- Canada

The economic contribution at the Canadian level is inclusive of the contribution at the Ontario and Waterloo region levels. Similarly, the economic contribution at the Ontario level is inclusive of the Waterloo region level. The contribution at the Canada and Ontario levels is estimated directly from the model based on input-output multipliers published by Statistics Canada. The Waterloo region contributions are estimated as a proportion of the Ontario contributions, based on the concentration of industries impacted by the University’s expenditures (using a location quotient methodology discussed in Appendix C).

The results of our analysis tell a compelling story of significant and important economic impacts that take on several dimensions. The University of Waterloo can be viewed as a national asset and contributor to Canadian economic competitiveness as well as a leader in the Greater Kitchener-Waterloo community.

²¹ For the purpose of this study, Waterloo region is defined to encompass, Kitchener-Cambridge-Waterloo Census Metropolitan Area, Toronto Census Metropolitan Area, London Census Metropolitan Area, and Hamilton Census Metropolitan Area.

2.5. The University's role as a significant employer within the region

The localized dimension of contribution to the economy is the University's capacity as a major employer within the Waterloo region, and key buyer of goods and services. The University can be viewed as a stable employer relative to employers in other segments of the economy prone to cyclical volatility and is a sought after employer as seen in its rankings as one of Canada's Top 100 Employers and the Waterloo Area's Top Employers²².

In consultations with local economic development leaders, the University is viewed as one of the largest, and most significant non-manufacturing employers in the region. Much of this significance comes from the quality of employment opportunities that the University is able to extend to the local labour force. For instance, in 2017 the University employed 1,287 full time faculty members (ranked 3rd largest among Ontario's six most research-intensive universities).²³ Given that these affiliated roles can be long term in nature, the University's capacity to support sustainable jobs within the region is an important contributor to local economic resiliency and economic development.

2.6. Economic contributions from capital and operating expenditures

Secondly, the University is able to produce significant economic impacts from expenditures related to the day-to-day operations as well as its capital investments. The University's 4.5 km campus is expansive and is home to several premier research and teaching facilities and campus spaces that support a vibrant student life.

Based on data provided by the University, annual operating expenditures totaled **\$853M** in 2017-18 FY.²⁴ This figure includes spending on staff salaries and wages, materials and equipment, professional services, administrative support and others.²⁵

A breakdown of these expenditures by type is provided in the table below. Given the local nature of operational expenditures the vast majority occur within the Waterloo region. A detailed breakdown of expenditures by region is provided in Appendix C.

Table 1: Distribution of the University of Waterloo's Annual Operations Expenditures (2017-18 FY)

Expenditure Type	Total (2017-18 FY)
Salaries and Benefits	\$618.1M
Professional and business services	\$11.1M
General administration	\$27.8M
Office supplies	\$24.6M
Transportation and storage	\$7.2M
Office furniture and material purchase	\$9.8M
Equipment	\$22.8M
Computer hardware purchases	\$15.3M
Utilities	\$19.4M
Other Expenditures	\$93.8M
Municipal taxes	\$2.9M
Total	\$852.9M

Key Observations

- In 2017-18 FY operations expenditures represented over 70% of the University's total expenditures. With a large portion of the \$853M going toward salaries and benefits, the University is positively contributing to the region's economic prosperity.

²² University of Waterloo Recognized as one of Canada's Top 100 Employers. Web source: <https://content.eluta.ca/top-employer-university-of-waterloo>

²³ CUDO. 2017. Number of Instructional Faculty Members (Excluding Clinicians) in Each Category. Web Source: <https://cudo.ouac.on.ca>

²⁴ At the time this study was completed, the University's 2018/19 operating expenditure data was unavailable.

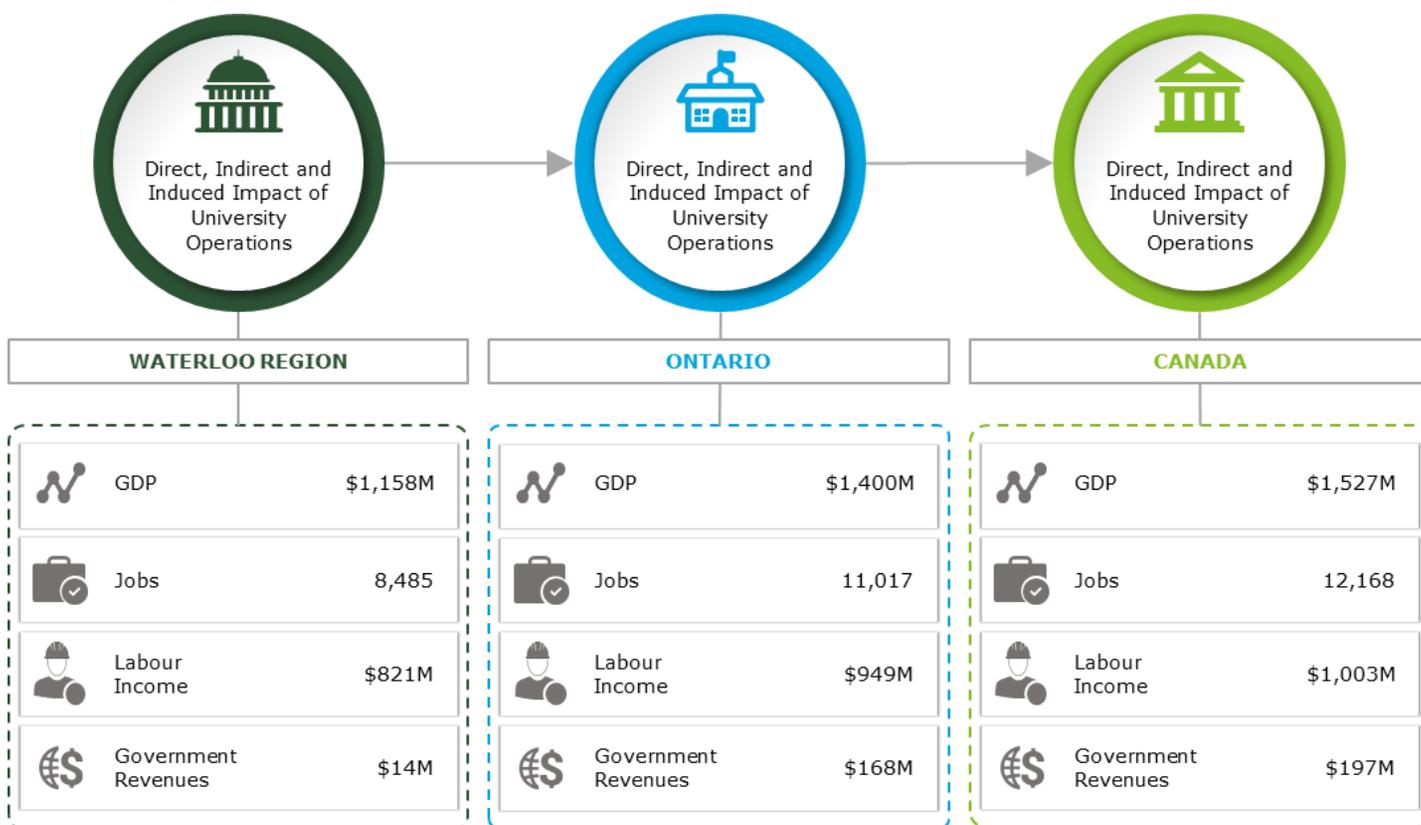
²⁵ Excluded from the analysis is \$121M allocated towards scholarships and bursaries to avoid risks of double counting with student expenditure analysis.

- Like many Canadians,²⁶ the faculty and staff of the University often choose to live within the region they are employed within and become active members of the community. Consequently, the University community spend salaries within the community contributing to local businesses and real estate markets.

2.7. Summary of the economic contribution from university operations

Operational expenditures contribute to a majority of the economic contributions of the University – demonstrating that the University’s presence in the region is a significant asset to the community. The impact of operational expenditures is particularly large to the regional economy given that the majority of operational expenditures are for University payroll.²⁷ The economic contributions from these expenditures for the year 2017/2018 are as summarized below.

Figure 4: Direct, Indirect, and Induced University Operating Expenditure Contribution to GDP, Labour Income, Employment and Government Revenue



- Local Impact: Accounting for the direct, indirect and induced impacts, it is estimated that the University’s operations contributed **\$1,158 million** to the local GDP, of which **\$821 million** in labour income and created or sustained **8,485** full-time equivalent (FTE) jobs across the Waterloo region and added an estimated **\$14 million** to the region’s government revenues.
- Provincial Impact: Accounting for the direct, indirect and induced impacts, it is estimated that the University’s operations contributed **\$1,400 million** to Ontario’s GDP, of which **\$949 million** in labour income and created or sustained **11,017** full-time equivalent (FTE) jobs across Ontario and added an estimated **\$168 million** to Ontario’s government revenues.

²⁶ Statistics Canada. 2016 Census of Population. Statistics Canada Catalogue no. 98-400-X2016328. Data extracted July 24th 2019. Web source: <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/dt-td/Rp-eng.cfm?APATH=3&DETAIL=0&DIM=0&FL=A&FREE=0&GC=0&GID=0&GK=0&GRP=1&LANG=E&PID=111334&PRID=10&PTYPE=109445&S=0&SHOWALL=0&SUB=0&THEME=125&Temporal=2016&VID=0&VNAMEE=&VNAMEF=>

²⁷ It is assumed that wages and salaries will be spent within the Ontario economy, generating sales for local businesses which also allocate a portion of those sales as wages and salaries which are again circulated through the economy to produce large induced multiplier effects.

- National Impact: Accounting for the direct, indirect and induced impacts, it is estimated that the University's operations contributed **\$1,527 million** to Canada's GDP, of which **\$1,003 million** in labour income and created or sustained **12,168** full-time equivalent (FTE) jobs across Canada and added an estimated **\$197 million** to Canada's government revenues.

For a breakdown of economic contribution by direct, indirect and induced impacts please refer to Appendix D.

2.8. Summary of the economic contributions from University capital expenditures

The University's expenditures on capital investments totaled **\$53M** in 2017-18 FY.²⁸ This includes spending on building repairs/renovations, materials and equipment and other expenses²⁹.

A breakdown of these expenditures by type is provided in the table 2. According to the University, suppliers and contractors are predominately located in Waterloo region. A detailed breakdown of expenditures by region is provided in Appendix C.

Table 2: Distribution of the University of Waterloo's Capital Expenditures

Expenditure Type	Total (2017-18 FY)
Building repairs/renovations	\$47.8M
Office furniture and material purchase	\$1.6M
Equipment	\$2.9M
Computer hardware purchases	\$1.1M
Total	\$53.4M

Key Observations

- Relative to operating expenditure, capital expenditures are contributing a smaller proportion to the total annual expenditures, with the majority of expenses allocated to building repairs and renovations.
- However, the University is executing important capital projects such as investments in the Dana Porter and Davis Centre libraries³⁰, Student Life Centre/Physical Activities Complex ('SLC/PAC') expansion project³¹, and construction of the Columbia Icefield Field House (CIF Field House)³².
- These renovations will allow the University to offer students better amenities, larger study areas and consolidated computing services.

²⁸ At the time this study was completed, the University's 2018/19 capital expenditure data was unavailable.

²⁹ Expenditures incurred outside Canada were not included in estimating the economic contribution of the University.

³⁰ University of Waterloo. 2019. Library. Web source: <https://uwaterloo.ca/library/about/our-mission/library-revitalization>

³¹ University of Waterloo. SLC/PAC Expansion Project. Web source: <https://uwaterloo.ca/associate-provost-students/slc-pac-expansion-project>

³² University of Waterloo Athletics. 2019. CIF Field House Grand Opening: Tuesday, September 17. Web source:

<https://athletics.uwaterloo.ca/news/2019/8/19/general-cif-field-house-grand-opening-tuesday-september-17.aspx>

Figure 5: Direct, Indirect, and Induced University Capital Expenditure Contribution to GDP, Labour Income, Employment and Government Revenue



The economic contributions from the University of Waterloo capital expenditures for the year 2017/2018 are as follows:

- **Local Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that the University’s capital expenditures contributed **\$44 million** to the local GDP, of which **\$31 million** in labour income and created or sustained **961** full-time equivalent (FTE) jobs across the Waterloo region added an estimated **\$1 million** to the region’s government revenues.
- **Provincial Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that the University’s capital expenditures contributed \$54 million to Ontario’s GDP, of which \$36 million in labour income and created or sustained 1,064 full-time equivalent (FTE) jobs across Ontario and added an estimated \$11 million to Ontario’s government revenues.
- **National Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that the University’s capital expenditures contributed **\$60 million** to Canada’s GDP, of which **\$39 million** in labour income and created or sustained **1,090** full-time equivalent (FTE) jobs across Canada and added an estimated **\$14 million** to Canada’s government revenues.

For a breakdown of economic contribution by direct, indirect and induced impacts please refer to Appendix D.

Taken together, the University of Waterloo, through its annual operations and capital planning is able to trigger important economic contributions. In addition to the value added and jobs created in the local, provincial and national economies via operational and capital spending, it is indirectly supporting the local and national population through supplier ecosystem contributions. Finally, the University is able to contribute tax revenue to different levels of the Canadian government which are consequently reinvested in public services and investments such as health care, public transportation, social services and education.

2.9. Economic contribution of out-of-town students

An important dimension to the University’s economic impacts is its ability to attract spending from people who otherwise would not be in the region. The University of Waterloo has been recognized as one of the top universities, and is thus able to attract students from across Canada and around the world.^{33,34} Among Ontario’s six most research-intensive universities, the University of Waterloo attracted the second largest share of full-time international students in 2017.³⁵ Spending from these out-of-town students attending the University is a significant contributor in the local, provincial, and national economy and would not normally occur but for the University.³⁶

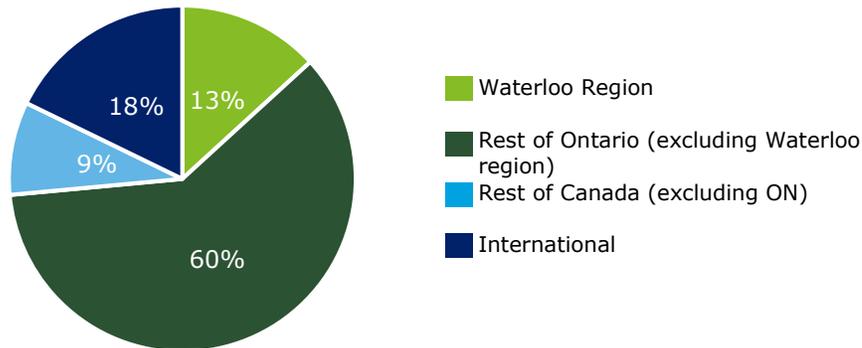


Students at a lecture

In the 2018/19 academic year, the University had approximately 39,000 students enrolled in its undergraduate and graduate programs. Of the total enrollment, approx. 5,000 full-time and part-time students lived on campus in residence.³⁷ As

shown in Figure 6, 13% of students originate from the Waterloo region, 60% are from other parts of Ontario, 9% of students are from other parts of Canada and the remaining 18% are from international locations.^{38 39} Taken together, 86% of the student body was from outside of the Waterloo region.

Figure 6: Distribution of University of Waterloo Students by Place of Origin 2018/2019



Source: University of Waterloo

For purposes of this study, we assume that without the presence of the University, out-of-town students would not have relocated to the Waterloo region. Accordingly, this study only measures the economic impact of out-of-town university student expenditures.⁴⁰

³³ Times Higher Education. 2019. Most International Universities in the world 2019. Web Source: <https://www.timeshighereducation.com/student/best-universities/most-international-universities-world>

³⁴ Research Infosource Inc. 2018. Canada’s Top 50 Research Universities 2018. Web Source: <https://researchinfosource.com/top-50-research-universities/2018/list>

³⁵ CUDO. 2017. Total Enrolment by Program. Web Source: <https://cudo.uwaterloo.ca>

³⁶ For purposes of this study, out-of-town students can be defined as students from Ontario (outside of the Waterloo region), rest of Canada, and other countries (international).

³⁷ University of Waterloo. Student administration system, as of November 1, 2016. Obtained from: <https://uwaterloo.ca/institutional-analysis-planning/university-data-and-statistics/common-university-data-ontario-cudo-0/common-university-data-ontario-cudo-2017>

³⁸ Data Provided by the University of Waterloo.

³⁹ Reporting on students that are international is less than those who would be reported if student Visa status was measured.

2.10. Quantifying student expenditures

Our estimate of student expenditures is based on the following assumptions:

- Typically, in addition to tuition, students from out-of-town spend on housing, food, retail, transportation and entertainment during their time at the University;
- All expenditures for tuition and required materials (e.g., books, supplies etc.) have been accounted for in Section 2.6 (Economic Contributions from Operating Expenditures);
- Students are typically enrolled in a full complement of courses year round (eight months for academic sessions and four months for work terms);
- 50% of part-time student expenditures have been deducted as being not attributable to the University; and/or
- 100% of housing and 50% of food expenditure is deducted for students living on campus

Table 3 shows the number of enrolled students in the University by geographic origin and term, while the average expenditure per month per full-time student is described below in Table 6.

Table 3: Students enrolled at University of Waterloo and On-campus residence by Place of Origin (Fall)

A majority of students enrolled in the Fall are attending the University full-time and are living off campus.

Student Origin	Full-time (Fall)	Part-time (Fall)	Total (Fall)	On-campus (Fall)	Off-campus (Fall)
Waterloo region	4,875	342	5,217	713	4,504
Rest of Ontario (excluding Waterloo region)	22,266	1,562	23,828	3,255	20,574
Rest of Canada (excluding Ontario)	3,207	225	3,432	469	2,964
International	6,567	461	7,028	960	6,068
All regions	36,915	2,590	39,505	5,396	34,109

Source(s): Number of full-time and part-time student obtained from University of Waterloo student headcount data; geographic distribution of student origin obtained from internal University of Waterloo data; Proportion of students living on-campus obtained from University of Waterloo, Student administration system, as of November 1, 2016.

Table 4: Students enrolled at University of Waterloo and On-campus residence by Place of Origin (Winter)

Over 85% of the students enrolled in Winter are Canadians that come from outside of the Waterloo region, with a large majority living off-campus.

Student Origin	Full-time (Winter)	Part-time (Winter)	Total (Winter)	On-campus (Winter)	Off-campus (Winter)
Waterloo region	4,726	316	5,042	624	4,418
Rest of Ontario (excluding Waterloo region)	21,587	1,442	23,029	2,849	20,181
Rest of Canada (excluding Ontario)	3,110	208	3,317	410	2,907
International	6,367	425	6,792	840	5,952
All regions	35,790	2,390	38,180	4,723	33,457

Source(s): Number of full-time and part-time student obtained from University of Waterloo student headcount data; geographic distribution of student origin obtained from internal University of Waterloo data; Proportion of students living on-campus obtained from University of Waterloo, Student administration system, as of November 1, 2016.

Table 5: Students enrolled at University of Waterloo and On-campus residence by Place of Origin (Spring)

The number of students enrolled in the Spring is significant due to the year round nature of course offerings as a result of co-op program participation.

Student Origin	Full-time (Spring)	Part-time (Spring)	Total (Spring)	On-campus (Spring)	Off-campus (Spring)
Waterloo region	2,983	411	3,394	184	3,210
Rest of Ontario (excluding Waterloo region)	13,623	1,879	15,502	839	14,663
Rest of Canada (excluding Ontario)	1,962	271	2,233	121	2,112
International	4,018	554	4,572	247	4,325
All regions	22,585	3,115	25,701	1,391	24,310

Source(s): Number of full-time and part-time student obtained from University of Waterloo student headcount data; geographic distribution of student origin obtained from internal University of Waterloo data; Proportion of students living on-campus obtained from University of Waterloo, Student administration system, as of November 1, 2016.

Table 6: University of Waterloo Student Living Expenses

Expense Category	Amount (\$/term)
Off campus accommodation	\$2,400
On campus food	\$1,132
Off campus food	\$940
Personal Expenditures	\$1,540

Source(s): University of Waterloo Budget Calculator; University of Waterloo. UW Food Services.

Based on the assumptions detailed above, Deloitte has estimated that total expenditures by out-of-town University of Waterloo students is approximately **\$399 million** over the 2018-19 academic year.

2.11. Summary of the Economic Contributions from Out-of-Town Student Expenditures

The economic contributions from out-of-town student expenditures for the year 2018/2019 are as follows:

Figure 7: Direct, Indirect, and Induced Out-of-Town Student Contribution to GDP, Labour Income, Employment, and Government Revenue



For a breakdown of economic contribution by direct, indirect and induced impacts please refer to Appendix D.

- **Local Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that out-of-town student expenditures contributed **\$303 million** to the local GDP, of which **\$149 million** in labour income and created or sustained **3,608** full-time equivalent (FTE) jobs across the Waterloo region and added an estimated **\$10 million** to the region's government revenues.
- **Provincial Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that out-of-town student expenditures contributed **\$358 million** to Ontario's GDP, of which **\$179 million** in labour income and created or sustained **4,210** full-time equivalent (FTE) jobs across Ontario and added an estimated **\$75 million** to Ontario's government revenues.
- **National Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that out-of-town student expenditures contributed **\$412 million** to Canada's GDP, of which **\$212 million** in labour income and created or sustained **4,831** full-time equivalent (FTE) jobs across Canada and added an estimated **\$97 million** to Canada's government revenues.

Our analysis reveals that the University's ability to attract new spending into the economy is significant. As detailed above, the University attracts students from across Ontario, Canada, and other countries. Specifically, local businesses that provide accommodation, food, and other services (e.g. entertainment, clothing etc.) can be supported by the continual, predictable flow of students that move to Waterloo every year to study at the University. Local suppliers may also benefit as the demand for goods and inputs to production rise to meet demand. This steady flow of potential customers into the region can provide stability for local businesses and offset other seasonal fluctuations in business by other customer groups. In this regard the University is able to stimulate new spending in the local economy that can support Canadian businesses and trigger reinvestment into the community.

Additionally, international students can make significant economic contributions over their life spans if they opt to stay in Canada or Ontario after graduation. Apart from spending on goods and services, the attraction of international students into the labour force can also help to address demographic challenges the Canadian economy is encountering such as population aging and the subsequent rising rate of retirements that is applying pressure on

firms to fill vacant positions.⁴¹ In addition, international students can diversify the cultures and perspectives in the Waterloo region and contribute to the diversity of the regional population.

2.12. Limitations of Economic Contribution Analysis of Out-of-Town Student Expenditures

Our analysis assumes that in absence of the University, out-of-town students would otherwise not be in the region. However, it is likely that students from other parts of Ontario, Canada and other countries may be attracted to the region to study at other local post-secondary institutions as well as to pursue employment opportunities.

It can also be noted that this analysis only captures the economic contributions of out-of-town student expenditures over the 2018/19 period. These figures do not capture the significant contributions that can accrue over the life span of international students who opt to stay within Canada or Ontario after graduation.

⁴¹ The Conference Board of Canada. Canadian Outlook Economic Forecast (Spring 2019).

3. The Notable Economic Contributions of the University of Waterloo Co-operative Education Program

3.1. About the University of Waterloo's Co-op program

The University's ability to trigger economic contributions through its presence in the region is only the beginning of its broader impact to the economy. While the classroom has always been the traditional setting for learning, ensuring students' skills, perspectives and experiences set them up for success in the labour market has increasingly become a key metric of success for universities, and the expectation of employers. The University has excelled in this regard, fueled by its globally leading Co-op program. Co-op education is an example of experiential learning and has become "a proven way to prepare students for a world in which change is accelerating and challenges are growing ever more complex."⁴² The University of Waterloo's Co-op Program is a truly differentiated feature of the University's impact to the economy. A classical, classroom based approach to teaching transfers skills to students in a singular way. In contrast, the Co-op Program transfers a set of tangible and intangible workplace skills that can reflect the current demands of the economy and are often difficult to access in classroom settings only. In this section we characterize the significant economic contributions of the program by assessing the following frames:



- Quantifying the value of the Co-op Program for employers



- Characterizing the benefits of the Co-op Program for participating employers



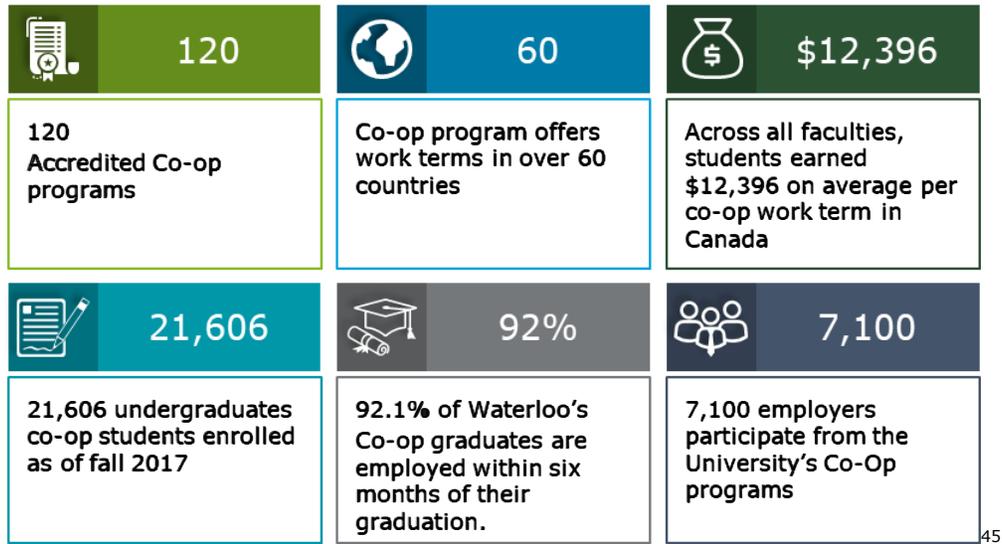
- Characterizing the benefits of the Co-op Program for participating students

The University of Waterloo offers the largest co-op program in the world, giving its students the opportunity to alternate between months of in-class study and months of on-the-job experience related to their degree program⁴³. The University has invested in relationships with premiere employers around the world to ensure high-quality experiences for students and has forged ties with more than 7,100 global employers⁴⁴. The Program is highly successful and expansive in its reach.

⁴² McKay, D. (2018, May 15). For students and employers, co-op education is bridge to a wider world. The Globe and Mail. Web Source: <https://www.theglobeandmail.com/report-on-business/rob-commentary/for-students-and-employers-co-op-education-is-a-bridge-to-a-wider-world/article24316976/>

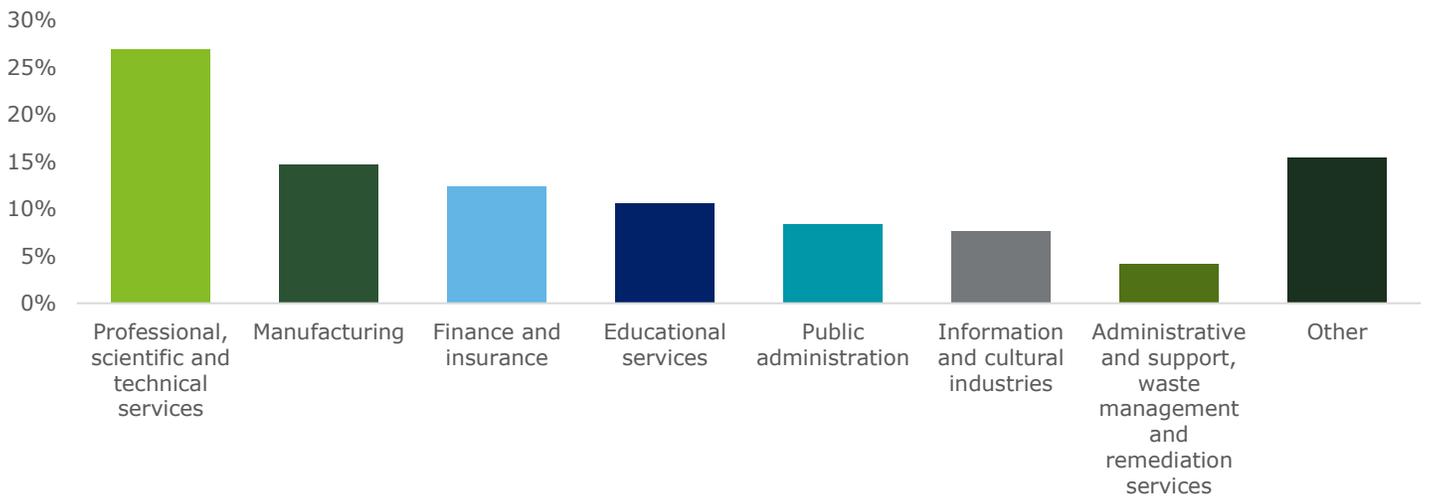
⁴³ University of Waterloo. 2019. World's largest co-op program. Web source: <https://uwaterloo.ca/hire/content/worlds-largest-co-op-program>

⁴⁴ University of Waterloo. 2019. Co-op & experiential learning.



The University's Co-op program provides opportunities for students to gain experience across a wide variety of industries for future employers. As described in the figure below, the largest share of Co-op students work in professional, scientific and technical services⁴⁸ (27%), manufacturing (15%), and finance and insurance (12%) industries.⁴⁹

Figure 8: Distribution of Co-op Work Term Industries 2018/2019



Source: University of Waterloo. Co-operative Education & Career Action

⁴⁵ 120 programs: University of Waterloo. 2019. About Co-operative education. <https://uwaterloo.ca/co-operative-education/about-co-operative-education>, 60 countries: University of Waterloo. 2019. Why co-op. <https://uwaterloo.ca/co-operative-education/why-co-op>

⁴⁶ <https://uwaterloo.ca/co-operative-education/about-co-operative-education>, 19,800 students: University of Waterloo. 2019. About Co-operative education. <https://uwaterloo.ca/co-operative-education/about-co-operative-education>, 89% employed: University of Waterloo. Why co-op | Benefits. <https://uwaterloo.ca/co-operative-education/why-co-op/benefits>, and 7,100 employers: University of Waterloo Statistics. 2019.

⁴⁷ University of Waterloo. 2019. Why co-op. Web Source: <https://uwaterloo.ca/co-operative-education/why-co-op/benefits>

⁴⁸ "This subsector comprises establishments primarily engaged in activities in which human capital is the major input. These establishments make available the knowledge and skills of their employees, often on an assignment basis. The individual industries of this subsector are defined on the basis of the particular expertise and training of the service provider". Statistics Canada.

⁴⁹ University of Waterloo. 2019. Co-operative Education & Career Action. Web Source: <https://uwaterloo.ca/co-operative-education-career-action/our-employers>

The ability for the Co-op program to provide opportunities across the economy is an important feature of the program's significant contributions to the economy. Students are able to work across different industries during their time as students. This enables students to cross pollinate best practices and theories from one industry to the next – contributing to a more agile, flexible labour force. Specifically, Co-op students in STEM fields are able to gain exposure to 'cross cutting' technology platforms such as automation, e-commerce, big data and artificial intelligence that can be applied across industries and are transferrable. Additionally, over 40% of the University's Co-op work terms occur in two of the most prominent industries in terms of economic activity, which are the professional, scientific and technical services industry and the manufacturing industry.^{50,51}

The Co-op program can also position participants competitively in the labour force. Today, employers are spending less time on training than they did two decades ago. Thus, individuals who have some level of pre-existing industry-relevant training, skills or exposure are favored by employers when compared to non-trained peers⁵².

3.2. Quantifying the value of the Co-op program for employers

The Co-op program can be seen as a 'win-win' for all involved. For students, the skills and experience gained through work terms can set them up for success in the future. For employers, the program can significantly contribute to business success. In consultations, employers that participate in the Co-op program stated there were several motivations to participate in the program including having access to a pipeline of talent, and accessing new ideas and innovation. Undoubtedly, these forms of business success can provide compelling reasons to participate in the Program. To adequately capture the range of benefits, we first quantify measures of employee gain that employers can access as a result of participating in the Program.

The benefit to an employer from hiring a Co-op student can be summarized as the value of economic output produced by the Co-op student, plus any subsidies received, minus wage and training costs (as summarized below).



Deloitte has estimated the average annual employer gain for University of Waterloo co-op placements in 2018/19. To do so Deloitte has:

- Estimated the economic output of a Co-op student based on typical employee output (defined as GDP per worker) in different industries. This average output is adjusted for the fact that co-op students cannot undertake all the tasks of an experienced employee;
- Reviewed eligibility requirements for subsidies for participating employers in Ontario;
- Reviewed University of Waterloo data on typical Co-op student wages; and
- Estimated Co-op training costs based on average employee training cost figures reported for employers in Canada.

In the forthcoming section, we detail the characteristics of each dimension of this calculation.

Co-op student output

Co-op employers benefit from the economic output produced by a co-op student. While the productive capacity of a Co-op student is less than an experienced worker, they are still economically productive and their ability to match the productive capacity of an experienced worker increases with the duration of a co-op placement.

Deloitte has modelled the economic output value of a Co-op student for different types of Co-op placements. To accomplish this, we have used Statistics Canada data on GDP and employment for different industries.⁵³ We have combined this information with existing literature on the productive capacity of a Co-op student in terms of the extent to which they can replicate tasks undertaken by skilled workers.⁵⁴ Thus, our analysis is adjusted for the fact that a

⁵⁰ The economic activity is measured by the Gross Domestic Product (GDP).

⁵¹ Statistics Canada. Table 36-10-0434-06 Gross domestic product (GDP) at basic prices, by industry, annual average, industry detail (x 1,000,000)

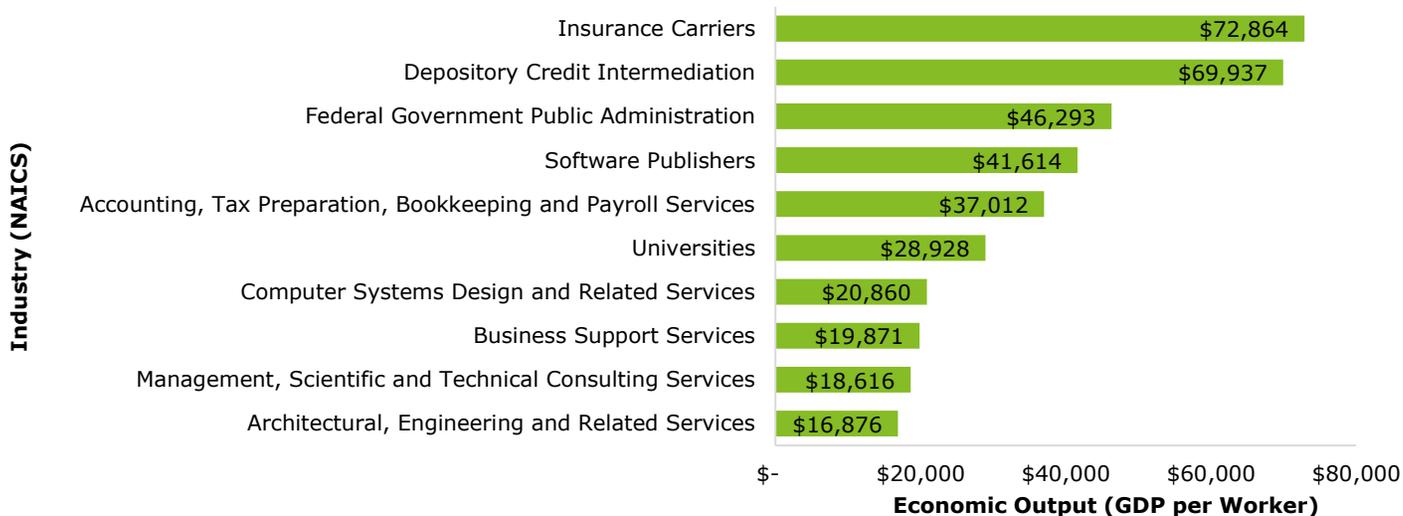
⁵² Institute for Competitiveness & Prosperity. The Labour Market Shift | Training a highly skilled and resilient workforce in Ontario. Working Paper September 2017.

⁵³ GDP data obtained from Statistics Canada Table 36-10-0402-01; Employment data obtained from Statistics Canada Table 14-10-0202-01

⁵⁴ Hogarth and Hasluck (2008), "The Net Benefit to Employer Investment in Apprenticeship Training".

Co-op student can be viewed as someone undergoing a training process, and thus not as productive as an experienced worker. Figure 9 shows Deloitte estimates of the economic output produced by Co-op students for ten industries with the highest number of Co-op placements in 2018/19.

Figure 9: Average value of the economic output produced by a Co-op student per work term in Ontario, for select industries, 2018/19



Source: Deloitte analysis

The link between a Co-op work term and the economic output is not only related to the wages in each industry. As an example, the economic output of a federal government public administration Co-op student is the third highest among the Co-op work terms shown in Figure 9, despite the fact that average wages for federal government public administration occupations are relatively low compared with industries such as software publishers.⁵⁵ Although the software publishers industry might produce a more valuable output (on a per worker basis) than federal government public administration, Co-op students can work much closer to the output of an experienced worker than is the case for Co-op students in the software publisher industry.

Co-op subsidies

Another dimension to the advantages businesses can gain by participating in the Program is through the subsidies they can potentially access to offset costs associated with hiring Co-op students. Business are often eligible for subsidies to assist with Co-op training and wage costs. For example, the Government of Ontario has a Co-operative Education Tax Credit where small and large corporations can respectively claim 30% and 25% of expenditures (up to \$3,000) per work placement.⁵⁶ Any Ontario employer hiring students from a post-secondary co-op program is eligible as long as the placement is between ten weeks and four months long.

Co-op Wages

Relative to full time employees, Co-op students have relatively low wages that are accrued for a shorter period of time. This can reduce the financial risk associated with participating in the program, or other mechanisms of experiential learning (e.g. internships). Often, multiple Co-op students can be hired for the same (or lower) wage costs than a typical university graduate salary. Despite relatively lower wages, Co-op students can quickly make a positive economic contribution during their Co-op terms. Thus, using Co-op students to carry out tasks may improve business margins, given the reduced wage pressures compared with other experienced hires.

According to University data, the average hourly earnings for a Co-op student is \$20.67 per hour.⁵⁷ However, hourly earnings tend to vary by Co-op program and work term level. On average, Co-op students in their first terms earn

⁵⁵ Statistics Canada Table 14-10-0204-01

⁵⁶ University of Waterloo. 2019. Tax Credits and Incentives. Obtained from: <https://uwaterloo.ca/hire/funding-opportunities/tax-credits-and-incentives>

⁵⁷ University of Waterloo (Hourly earnings information (January-December, 2018). Obtained from: <https://uwaterloo.ca/co-operative-education/why-co-op/co-op-earnings/hourly-earnings-information>

between \$16 and \$19 per hour, while Co-op students in their fifth term earn an average of \$25 to \$26 per hour.⁵⁸ Thus, co-op students are earning an hourly wage that is above the provincial general minimum wage.⁵⁹ In consultations, employers participating in the Co-op program emphasized the productive capacity of co-op students. In particular, students in their final years of undergraduate studies begin to approximate the skill level of entry level positions. Viewed this way, employers can have access to advanced critical thinking skills analogous to those in the full-time employment market.

Training Costs

In addition to wage costs, there are also training costs associated with hiring a co-op student. More experienced workers need to spend time training the Co-op student to learn new skills and be productive. As a result there is a cost associated with staff time.

- To identify the scale of these costs, we reviewed relevant literature and found that Canadian companies spend on average \$899 per employee on learning and development.⁶⁰
- The majority of learning and development expenditures (74%) is allocated towards staff salaries and external learning providers. Remaining expenditure items include employee tuition, technology, learning facilities and other items.

Based on the assumptions detailed above and total number of Co-op work terms in 2018/19, Deloitte has estimated that the total benefit to employers that have hired a Co-op student is approximately \$525 million over the 2018/19 academic year. The table below provides a breakdown of benefit – measured as economic output plus subsidies less training and wage costs.

Table 7: Estimated total employer gain from the University of Waterloo’s Co-op Program

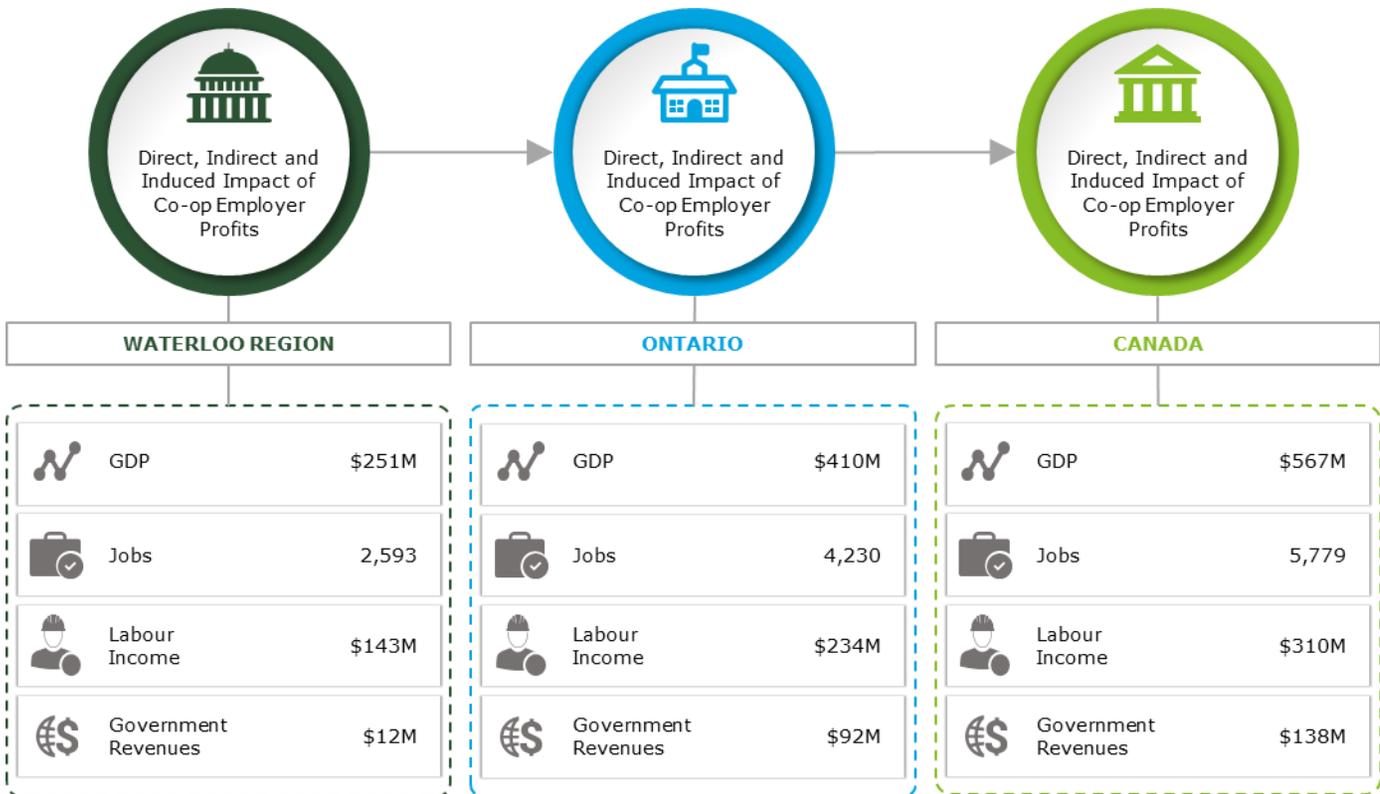
Key Component	Organizational Benefit, 2018/19
Total Economic Output	\$744M
Total Subsidies	\$68
Total Wages	\$267M
Total Training Costs	\$21M
Total Co-op Employer Gain	\$525M

⁵⁸ University of Waterloo (Hourly earnings information (January-December, 2018))

⁵⁹ Government of Ontario. 2019. Minimum wage. Web source: <https://www.ontario.ca/document/your-guide-employment-standards-act-0/minimum-wage>

⁶⁰ The Conference Board of Canada. Learning and Development Outlook. January 2018.

Figure 11: Direct, Indirect, and Induced Co-op Program Contribution to GDP, Labour Income, Employment, and Government Revenue



For a breakdown of economic contribution by direct, indirect and induced impacts please refer to Appendix D

Summary of the Economic contributions from increased Co-op employer profits

The economic contributions from increased Co-op employer profits for the year 2018/2019 are as follows:

- Local Impact: Accounting for the direct, indirect and induced impacts, it is estimated that increased Co-op employer profits contributed **\$251 million** to the local GDP, of which **\$143 million** in labour income and created or sustained **2,593** full-time equivalent (FTE) jobs across the Waterloo region and added an estimated **\$12 million** to the region’s government revenues.
- Provincial Impact: Accounting for the direct, indirect and induced impacts, it is estimated that increased co-op employer profits contributed **\$410 million** to Ontario’s GDP, of which **\$234 million** in labour income and created or sustained **4,230** full-time equivalent (FTE) jobs across Ontario and added an estimated **\$92 million** to Ontario’s government revenues.
- National Impact: Accounting for the direct, indirect and induced impacts, it is estimated that increased Co-op employer profits contributed **\$567 million** to Canada’s GDP, of which **\$310 million** in labour income and created or sustained **5,779** full-time equivalent (FTE) jobs across Canada and added an estimated **\$138 million** to Canada’s government revenues.

Corporate profits can drive important contributions to the economy. Companies are able to take profits and reinvest them in productivity-enhancing ways. For example, companies can invest in their people which can improve the quality and strength of their workforce and help to increase employee retention as employees are gaining relevant skills and competencies. Companies can also increase their productivity by investing in new technologies and machinery which can drive efficiencies and help companies retain a competitive edge.

In Canada, stimulating additional business investment has been a key challenge in the economy.⁶¹ Over time, these delayed investments can slow economic growth and expose Canadian companies to falling behind their global peers. Thus, the University's ability to help support corporate profits via the Co-op program can be viewed as a valuable dimension that supports business investment thereby addressing a key challenge in the economy.

3.3 Limitations of Economic Contribution Analysis of the Value of Co-op Program for Employers

While the University of Waterloo's tax linkage analysis identifies that graduates from all streams of programs, including co-op students, can have an earning premium relative to students from other Canadian universities, the contribution of the university to these increased earnings for Co-op students is only qualitatively described. There are a range of factors that can influence the wage an individual is able to command in their career. Examples of these factors include one's level of education, and the caliber of institution(s) they attended but also extends to a broader range of elements including one's age, gender, socioeconomic status, location, industry, and the breadth of an individual's personal and professional network. The scope of this study did not include gathering the comprehensive data that comprises consideration of such factors in addition to attendance to the University of Waterloo. As a result, this prevents us from clearly attributing any observed wage premiums solely to the Co-op program or the University of Waterloo more broadly.

3.4 Additional Benefits of the Co-operative Education Program for employers

In addition to the quantifiable gain employers can recognize as a result of participating in the Co-op program, there are several additional benefits that contribute to broader economic competitiveness. The extent to which Canadian companies are able to access the best talent to innovate and drive profit is a key determinant of economic growth. The 'race for talent' sees employers vying for the highest quality workers as a mechanism to maintain competitive advantage. Participation in the Co-op program is one vehicle through which Canadian companies have chosen to remain competitive.

In consultations with employers, the University's professional, organized approach to connecting businesses to Co-op students was viewed as 'best in class'. The University's ability to identify and channel students to meet the needs of businesses was viewed as superior, and reduced the time and effort required by employers to hire the next generation of leaders. For employers, the benefits of participating in the program are clear and include advantages as summarized below.

Development a pipeline of world class talent

In consultations, employers were unanimous in their view that the Co-op program is a tool through which companies develop a pipeline of talent for the future. Employers are able to view and evaluate potential full-time hires up close, and train students with the specific skills they need to be successful team members in the future. Notably, the University can allow students to adjust their schedule to enable placements of up to 8 months. These long-term placements enable them to fully integrate Co-op students into operations and projects.

In consultations with **a major financial services company**, Co-op students were viewed as an integral part of resource planning for busy audit and tax seasons. The company specifically hires students in offices across Ontario, Quebec and Massachusetts as a means to achieve corporate objectives while simultaneously providing students training to prepare them for the demands of industry. Thus, students are able to see major deliverables from 'start-to-finish' in key annual reporting cycles. This experience can enable students to see the outcome of their team's work and to fully assess their fit within an industry. Students are exposed to clients, and business leaders during key periods within the company's annual cycle and are able to work alongside full-time employees to tackle shared objectives. Importantly, the company uses the Co-op program across business lines offering placements in actuarial, financial, accounting and human resources related roles. The company actively reviews and monitors the performance of students during their terms to identify potential top talent to provide full time offers to. The company framed participating in the Program as a mechanism to win a difficult race for talent within their industry and 'vital' to their talent planning.

A source of new ideas and perspectives

University of Waterloo Co-op students often have a diverse range of skills, experience and exposure. In particular, co-op students in senior years of their degrees can often have experience at multiple companies within an industry,

⁶¹ Quinn, G. "Business investment intentions flat as Canadian economy plateaus". Financial Post. January 2019. <https://business.financialpost.com/news/economy/business-investment-intentions-flat-as-canadian-economy-plateaus>. Accessed July 30 2019.

which can provide a unique lens on business challenges employers face. Accordingly, employers noted they don't rely on Co-ops for 'busy work' but instead integrate them into core business and strategy problems.

In consultations with a **major multinational automotive company** that has participated in the program for 20 years, the company stated that Co-op students have had lasting impacts to their business. The company hires approximately 90 per cent of its Co-op students exclusively from the University of Waterloo, with a longstanding relationship with the Faculty of Engineering. The company has stated that Co-op students can have new perspectives that can be invaluable and thus task Co-op students real production related challenges for which they are to find an innovative, new solution.

- For example, students are given the task to identify potential efficiency enhancements related to the car production process and asked specifically to leverage what they have learned from Co-op terms in other industries to help develop an 'out of the box' solution. Ideas generated by students are then tested and prototyped in collaboration with the broader team.
- To help equip the students to develop potentially applicable solutions, they are taught the company's formal problem identification and solving methodology, setting students up to be able to put forward solutions that could be implemented and to translate the merits of their ideas to business leaders.

Contributions to social and corporate responsibility initiatives

Employers noted that Co-ops extended their impact during placements to actively participate in corporate social responsibility initiatives such as food drives, clothing drives and other charitable fundraising. These activities can be seen as a further demonstration of the University's social impacts to Canadian communities. Students at a **major financial services company** for example helped to execute a used clothing and food drive for local charities which can be seen as another example of how the university extends its presence in the community.

Broadening the network of company alumni

In consultations, companies acknowledged that in instances where Co-op students are not hired full time, they continue to develop long term relationships with them as they enter and mature into the workforce. This can enable companies to maintain a vast network of former employees that can be a key channel for business referrals, supplier relationships and talent referrals. In consultations with a major technology company, it was noted that Co-op students often 'cross-refer' their colleagues years after graduating. For the talent team at the company, Co-op students are a valuable additional source of potential new talent.

3.5 Benefits to participants of the Co-op Program

Part the Program's excellence is its ability to provide a simultaneous, dual benefit for employers and students. The benefits of the Co-op program are realized not just by employers, but most by the students – the next generation of our workforce. For participants, specific career and economic advantages can come as a result of participating in the program. In consultations with current and former students enrolled in the Program as well as successful alumni of the Program, the following set of key advantages associated with participating in the Program was identified.

Higher salaries

By the time a student graduates, they can have up to two years of real life work experience. As a result, they can be in a position to command higher salaries from future employers who value the skills and exposure gained during the Co-op program.

- In 2015, over 80% of recent Waterloo Co-op graduates earned over \$40,000 annually 6 month post-graduation compared to 40% for Ontario system graduates, which includes graduates from all Ontario universities.⁶²
- According to the 2015 Ontario University Graduate Survey, 80% of Waterloo Co-op graduates are earning over \$50,000 annually two years after graduation.
- Available data on co-op wage premiums shows variation by program.⁶³ In particular, there are significant positive premiums associated for the University's co-op graduates within business, mathematics and

⁶² OUGS 2015 survey

⁶³ University of Waterloo. Earnings of Post-Secondary Graduates – A Tax Linkage Approach.

computer science disciplines.⁶⁴ A breakdown of wage premiums five years post-graduation for the University of Waterloo's Co-op students versus the average for all other participating Canadian university graduates (excluding the University of Waterloo) as reported in the tax linkage analysis⁶⁵ is provided below:

- Business (35.9%)
- Mathematics & computer science (35.6%)
- Social science (23.9%)
- Science and agriculture (19.0%)
- Engineering (3.6%)

It can be noted that wage premiums are also visible more generally. Data from the tax linkage analysis suggests that the University's graduates (across all program streams) tend to earn 16% more five years after graduation compared to the average for other Canadian universities.⁶⁶ In particular, the highest wage premiums five years post-graduation when comparing the earnings of the University's graduates (across all program streams) versus the Canadian university average (excluding the University of Waterloo) are observed in business (35.9%), mathematics and computer science (35.6%), and social sciences (23.9%) disciplines. These premiums can significantly alter an individual's career earning potential. Over time, a higher salary in the initial stages of one's career can compound and help to support higher wages through the lifetime of their career. During consultations, participants in the Co-op program expressed confidence in their ability to earn higher salaries than their peers after graduation. This confidence can have a positive impact on one's ability to plan for the future, as future spending and saving decisions are often made based on one's expected idea of future income.

Better long-term financial outcomes

Co-op provides students with a steady stream of income throughout university that complements their academic program. This source of income also serves to alleviate financial burden, and University of Waterloo's 2016 OSAP default rate was 1.3%, whereas the system-wide rate was 3.3%. Further to this, between 2013-14 and 2015-16, only 70% of University of Waterloo students eligible for OSAP are program recipients, suggesting that the income stream provided through the Co-op program directly funds students' education. In 2010, 50% of bachelor's graduates in Ontario owned debt, with an average debt of \$26,300 at the time of graduation.⁶⁷ This financial burden can prevent graduates from making important investments and postpone home ownership, investment or other more personal decisions such as getting married or having children.⁶⁸ The potential reduction of indebtedness can be significant to the economy.

Conversely, individuals with lower levels of debt can have enhanced mobility within the workforce. When individuals are not worrying about debt repayments, they may be more open to taking higher-risk, high-pay jobs and be more open to change jobs to increase income⁶⁹. Individuals with lower debt can also increase their spending ability and contribute to local businesses and the economy and may be better positioned to save for larger purchases (e.g. home ownership)⁷⁰.

Case Study: Krista Duncan

The Co-op program offers a setting for students to create new opportunities for their futures. Krista Duncan, a student in Speech Communication and Human Resources, chose to attend the University of Waterloo for this degree program and to access the Co-op program. Krista has already completed three terms with leading technology firms including Inluitive, BlueCat Networks, and WealthSimple. At the time of the consultation, Krista was also completing an eight month term at Microsoft. Krista highlighted that the Co-op program offered her work experience and financial opportunities beyond what she could have imagined.

⁶⁴ Wage premiums were calculated by calculating the percentage difference in annual earnings, 5 years since graduation, of the 2005 entry cohort (UW's co-op graduates and graduates of Canadian Universities excluding the University of Waterloo).

⁶⁵ The analysis of Canadian universities in the University's Tax Linkage study include major universities across Alberta, British Columbia, Ontario and Newfoundland.

⁶⁶ University of Waterloo. Earnings of Post-Secondary Graduates – A Tax Linkage Approach.

⁶⁷ National Graduates Survey, Student Debt From All Sources, by Province and Level of Study. Web source. <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3710003601#timeframe>

⁶⁸ How Student Debt is Destroying the Economy and How We Can Stop it. Web Source: <https://www.forbes.com/sites/investo/2018/11/08/how-student-debt-is-destroying-the-economy-and-how-we-can-stop-it-in-its-tracks/#446117e86619>

⁶⁹ Di Maggio, Marco, Kalda, Ankit and Yao, Vincent. Second Chance: Life Without Student Debt. National Bureau of Economic Research. 2019

⁷⁰ Ibid.

Case Study: Krista Duncan cont'd

During her placements at Inluitive and Wealthsimple, Krista made a great impression and was given an offer to work on a part-time basis during school terms. As a result, Krista has been earning an income for a large proportion of her undergraduate studies. Krista was able to use this additional income in important ways, including paying for University fees and saving.

Acquisition of skills earlier on into their career

During Co-op placements, Co-op students are able to gain skills that are valuable in the labour force that they may otherwise not be able to have access to until much later in their careers. Importantly, these skills can often be difficult to gain in the classroom. Taken together, Co-op program participants can enter the work force with a head start in the key methodologies and contexts of the industries they work in.

In addition to tangible practical skills, Co-op terms enable students to learn the language, cadence and expectations of the professional workforce – a bundle of perspectives and skills can be vital to workplace success. For example, Co-op students are formally evaluated by their employers at the end of their placements, and thus learn the art of receiving and executing upon performance evaluations.

In consultations with students, Program participants stated that this exposure helped them to understand how to navigate the workforce, and how to create an environment of trust and honesty - qualities that are necessary in a thriving organization. It also ensures that they are able to communicate and debate in a positive manner. Students also frequently state they learned time management skills and how to juggle multiple tasks at a time. Students also learn to navigate in various corporate environments during their work placement and understand reporting structures, and how business decisions are made early in their career- giving them exposure to intangibles that are invaluable to one's career progression.



Students at ENV3

Case Study: Lauren McLennan

Lauren McLennan is an undergraduate student in Applied Health Sciences and is currently completing her third Co-op placement at Churchill Northern Studies Centre – a non-profit research station in Manitoba. Lauren acknowledges the role the University has played in her skills development. Taking advantage of the professional development course that was part of the Co-op program for her, Lauren was able to develop skills necessary to find her job such as resume development, interview skills refinement and skills identification.⁷¹ She was also able to experience one-on-one resume critiques, mock interviews and various workshops. Lauren views her placements made her more attractive to potential employers. While not certain of the career path she wishes to take, she believes she was able to develop invaluable skills during her placements, such as the ability to manage competing priorities that could help her transition to full-time employment.

Ability to develop a professional network earlier in life

The presence of a professional network of peers, mentors and employers is a critical dimension to success in the labour force. Research has showed that job search through one's network leads to a higher finding rate as well as better job quality both in term of wages and position⁷². Students enrolled in the Co-op program get to build an impressive professional network beyond their classmates and professors to peers and mentors in the workplace

⁷¹ University of Waterloo. 2019. Professional Development Program. <https://uwaterloo.ca/professional-development-program/courses/pd1-career-fundamentals>

⁷² ARBEX, Marcelo, O'DEA, Dennis, et WICZER, David. Network search: climbing the job ladder faster. *International Economic Review*, 2019, vol. 60, no 2, p. 693-720.

during their work terms. Additionally, over time, participants are able to refer each other within professional networks – thereby expanding the pool of people that can support career progression.

Case Study: Nathan Duarte

Nathan Duarte, an undergraduate student in biomedical engineering, chose to attend the University of Waterloo in large part due to its Co-op program. His program offers students the opportunity to learn about biomechanics, physics, chemistry and design and to apply the concepts during their work terms.⁷³

Like many of his peers in the Co-op program, Nathan leveraged the extensive network of Co-op alumni to find placements in his field. Currently working at Apple (California), Nathan was able to develop a personal and professional network that has been important to his career. After two placements in research at Harvard, Nathan chose to work at Synaptive Medical, a “global medical device and technology company” based in Toronto⁷⁴ where he met a colleague, a Waterloo alumnus, who would pass on Nathan’s resume to another Waterloo alumnus at Apple.

Successful transition into full time employment

In most sectors of the economy, the job market is highly competitive for recent graduates looking for entry level positions. The success of the co-op program can be viewed through the ability for graduates to successfully secure full-time jobs upon employment. In this regard, participants of the Co-op education program can have significant advantages.

- **Finding a job within one’s field:** In 2015, 86.9% of Waterloo graduates reported employment in positions matching the skills gained during their school years six months after graduation, compared to 79.0% of graduates from the Ontario system.⁷⁵
- **Shorter job hunt periods:** Additionally, 75.5% of Waterloo graduates occupied positions relating to their subject matter of study six months after graduation, versus 69.1% of Ontario system graduates.

These results tell a compelling story – Co-op students can be well positioned in the workforce. This success can be attributed to several mechanisms unique to the program:

- Co-op terms can provide a setting for students to identify where their natural aptitudes, interests and training best fit into the workforce.
- During Co-op terms, students are formally evaluated by employers. As students progress through work terms, they are given opportunities to apply feedback in the workforce and improve on areas of weakness which can enhance their confidence and skills as full-time employees. Work experience during Co-op placements provide students an opportunity to leave a positive impression to past employers and former colleagues, which can lead to informal referrals for full-time jobs.

Case Study: James Schnarr

James Schnarr is a recent Co-op graduate in Environment and Business. James specifically chose the University for its Co-op program, as his older brother also a Co-op alumni, encouraged him to enroll in the University based on his excellent experience. The program allowed James to experiment with different fields of study, eventually finding his passion – Product Management.

Like other students, upon graduation, James wanted to leverage his years of work experience into landing an ideal first job. By the time he graduated, James successfully completed five Co-op terms for four different employers including Accelerated Systems Inc., Blackberry Limited and Microsoft Canada. Throughout his work terms, he was given important exposure to his employers and feedback that helped him hone his skills. James initially had a focus on marketing during his co-op placements. However, after obtaining professional experience he realized his interests in Product Management. Ultimately, James was able to translate his experience as a Co-op student to a full-time Product Management role as he left a positive impression at a former co-op placement which led a contact to reach out and offer him a role at a new company before he graduated. By securing a full-time job prior to graduating, James was able to start working quickly after graduation and forgo potentially long job search periods.

⁷³ University of Waterloo. 2019. Biomedical Engineering. Web source: <https://uwaterloo.ca/future-students/programs/biomedical-engineering>

⁷⁴ Synaptive Medical. 2019. Web source: <https://www.synaptivemedical.com/>

⁷⁵ 2015 Ontario University Graduate Survey

4. The University's Success in Supporting Entrepreneurship

4.1. The University's ability to stimulate entrepreneurship

Another dimension of the University's significant space in the Canadian economy is its position as a hotbed of innovation and entrepreneurship. A 2019 study of Canadian private technology companies that have accumulated funding above five million dollars, found that the University of Waterloo is the top school in terms of the number of founders that they have provided undergraduate education (18.6%).⁷⁶ The University of Waterloo's history of supporting entrepreneurship dates back to its founding principles. In this section, we summarize and characterize the mechanisms through which the University has been successful in supporting entrepreneurship as follows:



- Characterizing the University's creator-owned intellectual property



- Characterizing the University's incubator and accelerator ecosystem



- Leveraging the University's alumni community to support the next generation of entrepreneurs



- Embedding entrepreneurship into teaching



- Estimating the economic contributions of a sample set of Velocity and Accelerator Centre companies



- Examining venture capital characteristics of University of Waterloo founded companies

Each of these dimensions can be viewed as a contributor to Canadian economic prosperity as "innovation is widely recognized as the ultimate driver of long-term economic growth."⁷⁷

4.2. Characterizing the University's creator owned intellectual property policy

When speaking to alumni, several graduates noted that their desire to give back to the next generation of entrepreneurs was rooted in a sense of pride for being part of the University and wish to give back to a place that had significance in their lives. However, the University's success in this regard can also be seen as the outcome of a key strategic choice it made – to champion a 'creator owned' blanket Intellectual Property (IP) policy throughout the University⁷⁸.

⁷⁶ The University of Toronto – Impact Centre (2019). Tech Founder Education – Backgrounds of 585 Founders from 335 Canadian Tech Companies.

⁷⁷ Canada's Fundamental Science Review. Investing in Canada's Future. Strengthening the Foundations of Canadian Research.

⁷⁸ The university defines IP as "patents, copyrights, trademarks and the like, all of which provide legal protection for something that has real or potential commercial value.

Unlike classical approaches to university-sponsored/supported innovation, the University of Waterloo empowers entrepreneurs to retain ownership of patents associated with their discoveries. The University was a leader when it established this approach, which effectively removes the traditional negotiation process between the creator and institutions over the distribution of revenue resulting from a patent. By freeing entrepreneurs to reap the financial rewards of their discovery, the University is able to incentivize entrepreneurship, and provide greater ability for founders to recoup their own investment as their companies scale.

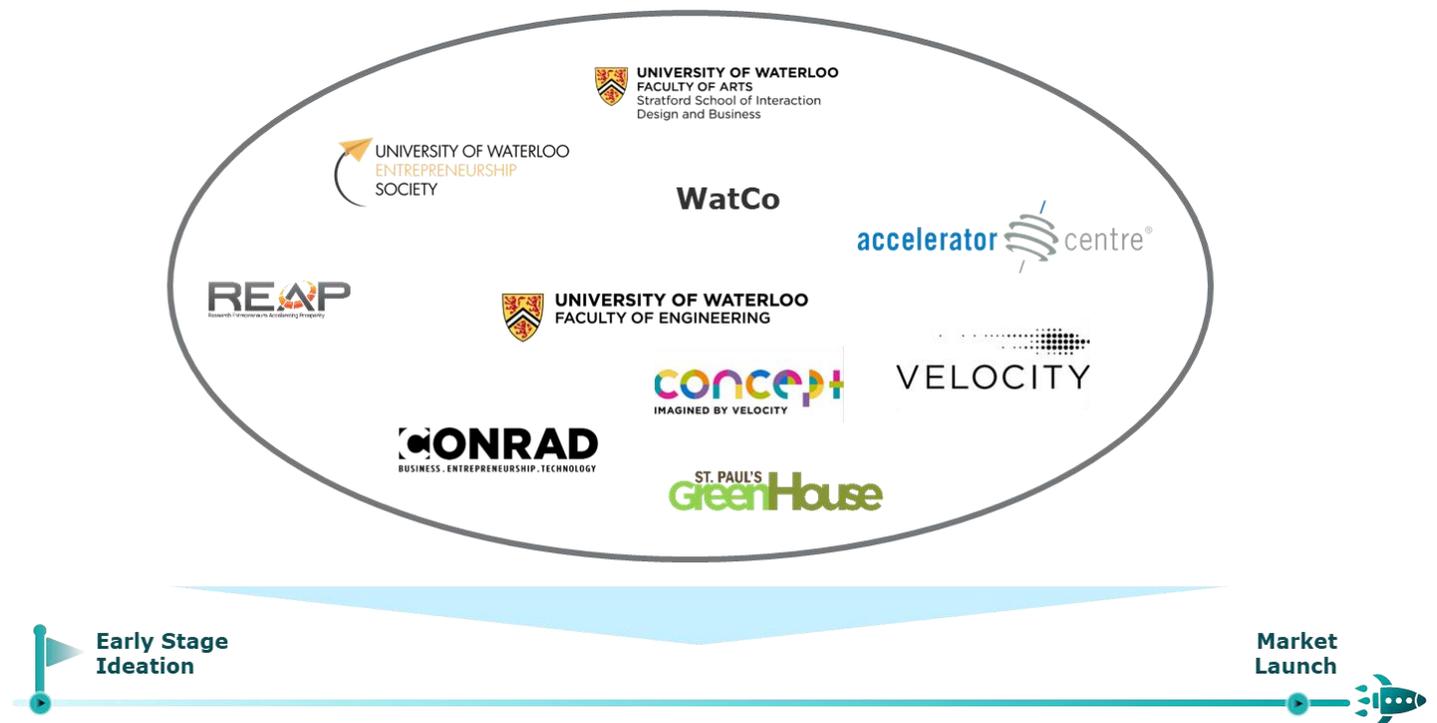
Moreover, the University’s IP policy is also able to stimulate and attract corporate partners who provide tangible funding, human resources and equipment in the form of shared research partnerships that benefit students and researchers. Similarly, the IP policy was identified, in consultations with University stakeholders, as a key mechanism through which the University is able to attract and retain some of the world’s leading experts to teach and research at the University.

The University’s creator-owned approach aligns to best practices and recommendations on the necessary conditions required to support innovation and entrepreneurship. For example, in 2017 Canada’s Fundamental Science Review study submitted to the Federal Advisory Panel found IP to be a critical determinant of innovation success and recommended policy makers to go beyond providing funding to entrepreneurs and ensure that they can retain intellectual property so as to decrease risk for inventors⁷⁹.

4.3. The University’s incubator and accelerator ecosystem

The University supports entrepreneurship through a suite of organizations specifically dedicated to supporting companies in all phases of the commercialization process from the early stages of inspiration and discovery, to the incubation and acceleration of commercial and social ventures.⁸⁰ Below we profile examples of the ecosystem of incubators and accelerators that are part of the University.

Figure 12: The Innovation Ecosystem at the University of Waterloo



Source: Deloitte Analysis 2019

Notably, the University provides support along several stages of the commercialization process. These organizations are not partnerships, but rather, embedded assets that receive funding from the University. Each of these

⁷⁹ Investing in Canada’s Future. Strengthening the Foundations of Canadian Research. 2017

⁸⁰ University of Waterloo. 2019. Entrepreneurship it’s in our DNA. Web source: <https://uwaterloo.ca/entrepreneurship/>

organizations provide a space for entrepreneurs to help bring their ideas to market and provide world class training in business, strategy and marketing that can set businesses up for success.

Case Study: Velocity

Velocity is an entrepreneurship program at the University of Waterloo with a highly competitive admission process, and is one of Canada's most productive startup incubators with a three-year company survival rate of 69%⁸¹. Velocity supports two main populations:

- **Student entrepreneurs:** Velocity supports students to build and expand on ideas and provides access to dedicated supports such as Velocity Start which hosts 17+ workshops, grad student events, panel discussions, and brainstorming sessions to give students and entrepreneurs the skills and experience to start and grow their business. The program executes start-up coaching and services and also provides study and meet up space to facilitate the generation of ideas. In consultations, Velocity noted that Co-op students are a key source of participants for its programs. Students are exposed to real world problems and come back with ideas on how to address them and one day turn them into viable businesses.
- **Startup companies:** Velocity is the home base to 80+ early-stage startups building technology-based businesses in the heart of Waterloo Region.



Students at a Velocity Science event on campus

Velocity also works with partners. In 2015, Velocity and Communitech partnered with Google and the Government of Ontario as part of their mission to advance growth in Waterloo region's technology sector.

Since its inception in 2008, Velocity has worked with startups as they discover, build, and scale business opportunities. Velocity does not charge rent or take equity to join, though many founders continue to contribute after they graduate from the program, both as real-world mentors and by supporting other founders in their journey to market success. In this regard, former participants deliver – by participating as real-world mentors and supporting participants in their journey to market success. In consultations, Velocity leadership stressed that founders that have graduated from Velocity often return and participate as mentors or leaders to new start-ups, creating a positive self-reinforcing cycle of entrepreneurship unique to the University's community.

⁸¹ University of Waterloo. 2019. Who we are. Web Source: <https://uwaterloo.ca/about/who-we-are/facts>

The University’s skilled approach to creating a hospitable environment for entrepreneurship has paid off. Since its founding, University of Waterloo alumni have become business leaders across Canada. The Waterloo region is 2nd only to Silicon Valley in terms of start-up density⁸². Patent levels are also three times higher than the Canadian national average⁸³. There are numerous examples of successful companies that have been founded by University of Waterloo alumni:

		
<p>John Baker completed his undergraduate degree in Systems Design Engineering and is the founder and president of Desire2Learn, now known as D2L, which makes the Brightspace educational software platform. The company says over 1,110 clients use Brightspace, which adds up to a total of close to 15 million individual users from kindergarten to government and healthcare workers.</p>	<p>North Inc., formerly known as Thalmic Labs, transitioned to making smart glasses at the end of 2018. It had previously developed a motion-controlled device called the Myo armband. North, formerly Thalmic Labs, builds a technology that is human centric and believes that people and technology goes hand and hand. The company has over 400 people spanning four offices across North America. The company has received over \$160 million in funding from investors including Intel Capital, the Amazon Alexa Fund and Fidelity Investments Canada⁸⁴.</p>	<p>University of Waterloo alumni Jason Tham, Kevin Wong, Sean Kirby and Jason Yuen founded Nulogy Corporation which creates customizable platforms to help brands achieve market success. The company is part of the SCALE.AI, a supercluster that consists of more than 120 companies shaping the global, digital supply chain and brings together retail, manufacturing, transportation, infrastructure, and information and communications technology sectors to build intelligent supply chains through artificial intelligence and robotics⁸⁵.</p>

Case Study: Clearpath Robotics

Clearpath Robotics, Inc. exemplifies a company that would not have been started had it not been for the University of Waterloo. The company was founded in 2009 by a group of four University of Waterloo graduates, and remains headquartered in the Waterloo region today. The original goal of Clearpath was to streamline field robotics research for universities and private corporations, but the company has since expanded and is now also manufacturing and selling the OTTO line of self-driving vehicles for industrial environments.

Matt Rendall, one of the founders who holds a Bachelors of Mechatronics Engineering degree and Masters in Business, Entrepreneurship and Technology (“MBET”) from the University of Waterloo. Matt spent 5 years at the University, graduating in 2008 and also participated in the Co-op program. During his Master’s degree, Matt was tasked with developing a case study of a new company – his case would eventually grow to be a globally leading manufacturer of self-driving vehicles.

Matt attributes the existence of Clearpath to the University given that the story of Clearpath begins at the University. Key dimensions of how the University supported Clearpath’s success include:

- **Facing a challenge from educators:** The genesis of Clearpath was analysis to support Matt’s Master’s thesis. While the company was not incorporated until after Matt graduated, the assignment shaped Matt’s original interest in robotics.

⁸² Why does Waterloo have the Highest Startup Density in the World after the Silicon Valley. Web source: <https://medium.com/uwaterloo-voice/why-does-waterloo-have-the-highest-startup-density-in-the-world-after-silicon-valley-3cbd006a5453>

⁸³ Ibid

⁸⁴ Kitchener’s Thalmic Labs secures nearly \$160 million from investors. Web source: <https://www.cbc.ca/news/canada/kitchener-waterloo/thalmic-labs-120-million-us-investment-myo-1.3768764>

⁸⁵ Canadian Supply Chain Innovator, Nulogy, Sets Sights on Global Expansion with Supercluster Funding Boos. Web Source: <https://nulogy.com/news-events/nulogy-news/canadian-supply-chain-innovator-nulogy-sets-sights-on-global-expansion-with-supercluster-funding-boost/>

Case study: Clearpath Robotics cont'd

- **Meeting co-founders:** All four of the company's co-founders are University of Waterloo graduates. Matt was able to meet co-founders during his time at the University organically due to the University's vibrant social life and emphasis on student networking and entrepreneurship.
- **Accessing the University's Accelerator Centre:** In the fourth year of his undergraduate studies, Matt was able to access resources at the Accelerator Centre that helped him to grow his idea into a formalized business plan, which laid the foundation for successful market launch.

Today, the company is achieving market success and contributing directly to the Waterloo region. The company employs approximately 250 employees in the region within three facilities totaling 100,000 square feet. The company has an ambitious goal to continue to grow the business – roughly doubling every year. Clearpath's product offering encompasses ten different types of robots, hardware, and software that have been sold online in 42 countries.

According to rule of thumb estimates provided by the company, Clearpath is also able to support the creation and/or retention of an additional 1,000 jobs through its supplier relationships.

Each of the aforementioned companies is a success story in its own right. Successfully starting and scaling a new company is extremely challenging and high risk. Business failure statistics show that about 96 percent of small businesses (1-99 employees) that enter the marketplace survive for one full year, 85 percent survive for three years and 70 percent survive for five years⁸⁶.

4.4. Leveraging the University's alumni community to support the next generation of entrepreneurs

A critical component to success as an entrepreneur is having the ability to test ideas with experts and mentors. The 2018 Entrepreneurship Census surveyed Canadian startups - when asked what support they require to grow, 42% stated mentorship was a critical requirement. At the University of Waterloo, students not only have access to world-class teaching faculty but also a network of alumni that work formally and informally to support entrepreneurs.

Specifically, stakeholders pointed to the culture of alumni giving back to the University as its 'secret weapon' in supporting entrepreneurs. Alumni give back to student entrepreneurs through participating in mentorship programs, and informal events (e.g., Hackathons etc.) where current students can benefit from the insights and direction of graduates. In consultation with alumni of the University, graduates expressed a deep sense of pride and community which can lead to meaningful, tangible support for the next generation of entrepreneurs.



Students at Hack the North

This atmosphere is particularly pronounced at Velocity. In consultations with Velocity, when asked what the most distinguishing feature of the University's approach to entrepreneurship was – leaders pointed to the embedded, helpful network of alumni that act as a resource to companies as they work through Velocity's programming.

- For example, graduates of Velocity that go on to access services at Y-Combinator, one of the world's premiere innovation incubators in California, come back to mentor entrepreneurs interested in accessing the program. Y-Combinator and Velocity alumni provide invaluable guidance on the application process and help companies decide whether to pursue additional support at Y-Combinator in the future thereby de-risking potential next steps, and providing invaluable perspectives to applicants.

⁸⁶ Statistics Canada. Key Small Business Statistics 2019.

- In addition, Velocity alumni were also identified to support entrepreneurs by acting as investors or connecting companies to other mentors, suppliers and buyers within their own network.

Seen this way, when students join the University they not only have access to world-class professors, they are also able to interact with a family of leaders in industry that can be important contributors to business success. By connecting alumni that fit this profile to students and faculty, the University is able to side step a key challenge in the Canadian economy. A recent report by the Centre for Digital Entrepreneurship and Economic Performance recently pointed out that the Canadian technology ecosystem lacks a quality network of mentors who can help companies grow and scale⁸⁷. Specifically, the Canadian economy can lack the presence of business leaders who are able to contribute back into entrepreneurial ecosystems with direct knowledge of how to navigate strategic regulations, harmonization, technology standards and IP regimes, and how to successfully scale a company.

4.5. Embedding entrepreneurship into teaching

Firstly, the University embeds entrepreneurship and business acumen throughout its approach by integrating a “progress-driven culture that embraces innovation and risk”⁸⁸. In the classroom, students are challenged with thinking through the real world applications of the content taught in the classroom. In consultations, former students were unanimous in their view that professors were quick to encourage students to consider ideating and consider transforming their interest in a topic into a business as a viable career path.

Entrepreneurship often stems from the willingness to find solutions to real world challenges. The University’s Co-op program also indirectly encourages a spirit of entrepreneurship at the University. In consultations with Velocity leadership, it was noted that current and former Co-op students were a large proportion of participants in entrepreneurship programs put on by the incubator. Co-op students go out into the workforce and gain exposure to the real world challenges faced by industry. This exposure often sparks their creativity and drive to start businesses.

In addition, the University also offers programs that take interdisciplinary approaches and are allowing students to study industry and societal challenges through various perspectives that can enable people to pinpoint market opportunities that can be transformed into businesses. In addition to classical, core degree programs, the University teaches several interdisciplinary degree programs that help connect theoretical training to practical challenges faced by society and the economy. Key examples include:

- The Conrad School of Entrepreneurship and Business: The immersive entrepreneurship school offers programs and courses to undergraduate and graduate students wishing to focus on the launch and development of new ideas in the startup and corporate environments.⁸⁹ Undergraduates engineering students can develop their entrepreneurial and business skills by choosing the entrepreneurship option.⁹⁰ The school also offers an Enterprise Co-op (E Co-op), granting co-op credit to students while they create their own business.⁹¹
- Specialized Hybrid Business Programs: The University gives students the opportunity to add a business component to many majors by taking a specialized hybrid business program. Examples of hybrid business programs offered by the University include: computing and financial management, science and business or mathematics and business administration.⁹² Participations in these programs enables students to acquire various business skills such as marketing and accounting while also gaining technical skills, helping them stand out in the labour market.
- Velocity: The competition-based entrepreneurship program at the University of Waterloo, as well as one of Canada's most productive startup incubators, offers on-campus workshops, panel discussions, brainstorming sessions and other supports for students hoping to start and grow a business.

⁸⁷ Catalyzing Canadian Growth. Understanding the Role of Large Firms in Helping Small Businesses Succeed. Williams, Herman and Clarke

⁸⁸ University of Waterloo. 2019. Entrepreneurship It’s in our DNA. Web Source: <https://uwaterloo.ca/entrepreneurship/>

⁸⁹ University of Waterloo. 2019. Conrad school of entrepreneurship and business. Web Source: <https://uwaterloo.ca/conrad-school-entrepreneurship-business/about-university-waterloo-conrad-school-entrepreneurship-and>

⁹⁰ University of Waterloo. 2019. Entrepreneurship option in engineering. Web Source: <https://uwaterloo.ca/conrad-school-entrepreneurship-business/undergraduate/entrepreneurship-option-engineering>

⁹¹ University of Waterloo. 2019. Enterprise Co-op. Web Source: <https://uwaterloo.ca/conrad-school-entrepreneurship-business/undergraduate/enterprise-co-op>

⁹² University of Waterloo. 2019. Business Programs. Web Source: <https://uwaterloo.ca/future-students/programs/business>

Case Study: Dr. Alexander Wong

Dr. Alexander Wong is a real life example of a successful entrepreneurial professor that continues to give back to the University community and supports entrepreneurship. Dr. Wong is currently the Canada Research Chair in Artificial Intelligence and Medical Imaging, Member of the College of the Royal Society of Canada, co-director of the Vision and Image Processing Research Group, and an associate professor in the Department of Systems Design Engineering at the University of Waterloo. He had previously received the B.A.Sc. degree in Computer Engineering from the University of Waterloo in 2005, the M.A.Sc. Degree in Electrical and Computer Engineering and a Ph.D. degree in Systems Design Engineering from the University of Waterloo.

In 2017, Dr. Wong co-founded his company, Darwin AI with three of his graduate students who had similar interests in AI. Dr. Wong specifically wanted to support University of Waterloo students in their quest to explore AI, and has based his company in Waterloo, Ontario. To expose more students to his field, he also participates in the Co-op Program and regularly hires Co-op students from the University interested in AI. Today, approximately 90 per cent of the company's staff are University of Waterloo graduates or Co-op students.

The Darwin AI team has won numerous awards, including best workshop papers at the prestigious NIPS conference in 2016 and 2017. In 2018, the company raised \$3 million in seed funding, led by Obvious Ventures, iNovia Capital, and angels from the Creative Destruction Lab in Toronto⁹³. The company has also published numerous scholastic and empirical papers to validate our optimization claims. Taken together, Dr. Wong exemplifies the real world power of University of Waterloo entrepreneurial professors contributing to entrepreneurship in a full cycle.

Methodology to quantify the economic contributions of companies that have spun out of the University

Measuring exactly how the University is able to support the generation and growth of new companies is a complex exercise as companies that spin out of the university can have varying levels of direct connection to the University. The University has supported entrepreneurship in direct and indirect ways. For example, a graduate of Velocity can receive up to two years of dedicated mentoring and entrepreneurship support. In contrast, a student or graduate could develop IP during their time as a student, but elect to transform their interest into a business years after graduating.

For the University of Waterloo, quantifying the economic contributions of entrepreneur alumni is particularly challenging, as the University cannot actively monitor the career choices all alumni take. In addition, the University's unique "creator-owned" IP policy can also limit the extent to which the University is able to track alumni entrepreneurship activity⁹⁴. While this approach to IP can incent entrepreneurship and innovation, it can also create limitations on the extent to which the University can report on the number of firms that have spun out of the University, or their characteristics. As a result of these data limitations, our analysis likely will not fully capture the total number of companies that have spun out of the University.

For those companies that can be affiliated to the University, key data points that are useful to quantifying economic contributions (e.g. firm name, size, revenue) are often not publicly available or up-to-date. The extent to which a company is able to drive economic contributions is also dependent on its maturity and size. Younger companies for example can have smaller employment or revenue figures. Comparing start-up firms to larger more established companies that have successfully scaled without a bespoke methodology can cloud the true level of economic contribution of the University's alumni entrepreneurship community.

Finally, there are significant challenges associated with starting and scaling a business. There is a high likelihood that many of the University's spin off companies may not reach maturity. In order to capture the true economic footprint of these spin-off businesses obtaining data on survival rates are a crucial part of the analysis.

To overcome these limitations, Deloitte developed a tailored methodology that aims to quantify an estimation of the economic contributions of a sample of companies that have graduated from Velocity and Accelerator Centre programming that takes into account these contextual factors. This approach was intentionally designed to capture the diversity of companies that the University has supported through Velocity and Accelerator Centre (both organizations are part of the University) so as to examine a group of companies that could be meaningfully attributed to the University in some way.

⁹³ DarwinAI raises \$3 million for AI that optimizes neural networks. Web source: <https://venturebeat.com/2018/09/18/darwinai-raises-3-million-for-ai-that-optimizes-neural-networks/>

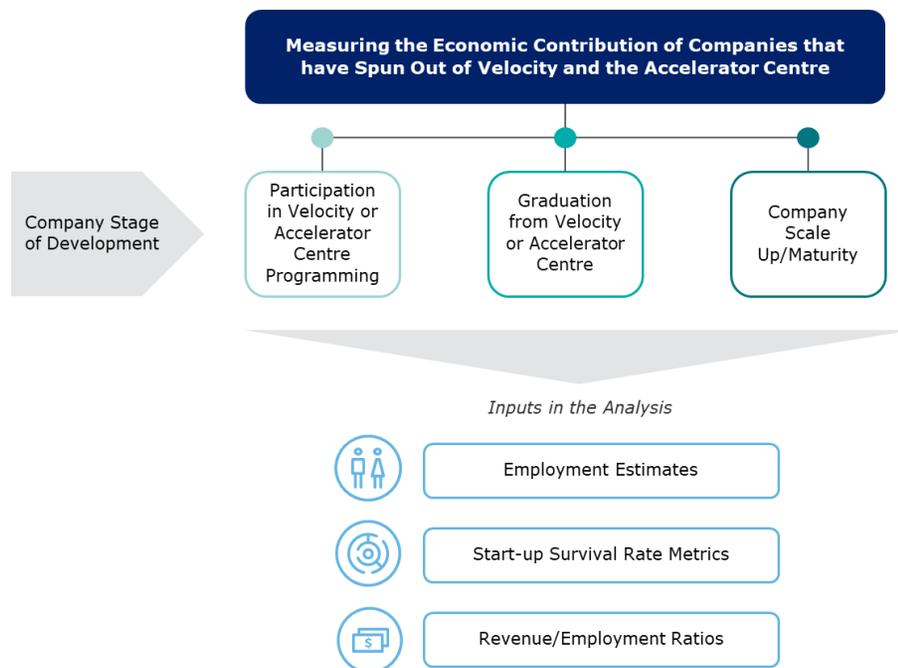
⁹⁴ At the time of the development of this study, the University does not have a comprehensive record(s) on the total number of companies that have spun out of the University.

This approach was also taken after consultations with local innovation leaders, as Velocity was identified as a 'key channel' of entrepreneurship support by the University with a large share of companies that have spun out of the University having accessed Velocity's services at some point in their history. It can be noted that Velocity tends to support companies within the early stages of the business life cycle (i.e. seed stage development) while other organizations within the University's ecosystem support later stage companies. Thus, the inclusion of a selection of firms that graduated from the Accelerator Centre has also been included as the Centre was noted to support companies in later stages of development. Taken together, both of these organizations can be seen as separate nodes of the University's support for entrepreneurship.

Analogous to Velocity, the Accelerator Centre offers a two year milestone based curriculum and one-on-one mentorship. Consultations with stakeholders have highlighted that companies either access Velocity or Accelerator Centre services. The University funds Velocity and Accelerator Centre and actively works to support its programming and support for entrepreneurs. As a result, assessing the economic contributions from a sample set of Velocity and Accelerator Centre programming graduates can be a meaningful way to ensure that companies that have been supported by the University are assessed.⁹⁵

For these sample set of firms, we used alumni employment data to approximate revenues using revenue to employment ratios for Ontario's High Tech industry.⁹⁶ This approach was selected given that the High Tech industry, as defined by BC Stats, encompasses firms that tend to be innovative and efficient, producing goods and services that drive economic growth and provide relatively high-wage employment.⁹⁷ Thus, we assumed the High Tech industry was a good proxy to measure the value of output produced by spin-off companies. A summary of the methodology undertaken to estimate the economic contribution of companies that have spun out of the University is provided in the figure 13.

Figure 13: Summary of the Methodology Used to Measure the Economic Contribution of Companies that have Spun out of Velocity and the Accelerator Centre



⁹⁵ Insight obtained from stakeholder interview.

⁹⁶ BC Stats. Profile of the British Columbia Technology Sector: 2017 Edition.

⁹⁷ According to BC Stats' Profile of the British Columbia Technology Sector, the industry-based definition of High Tech includes manufacturers of pharmaceuticals and other chemicals, computers and other electronic products, aerospace products and parts, and medical equipment and supplies. Also included are service industries such as engineering, computer services, motion picture and video production, surveying and mapping, scientific and technical consulting, telecommunications, and research and development.

To obtain an estimate on the employment supported by the sample set of Velocity participants, Deloitte made assumptions on the proportion of current and alumni Velocity companies, average employment size, and survival rates as follows:

- **Stage of development:** According to a sample set of 164 Velocity companies, 52% of Velocity participants are current companies while the remaining 48% are alumni companies that have graduated from Velocity.
- **Employment:** Based on the sample set of 164 Velocity companies, current Velocity companies have an average employment size of four employees. To determine the average employment size of alumni companies, a smaller sample set of 49 alumni companies supported by Velocity within the “growing” stage⁹⁸ were used due to the completeness of the data. These alumni companies were found to have an average employment size of 41 employees.⁹⁹
- **Survival Rate:** According to internal University data, the average five year survival rate of Velocity participants is 67%¹⁰⁰. To account for the turn-over rate of startups, these survival rates were used to discount the employment estimates. It is assumed that this five year survival rate is indicative of firm survival over the entire time period covered in our analysis (2008-2018).¹⁰¹

To ensure our analysis could be representative, we used these average employment sizes on the estimated number of current and alumni Velocity companies to obtain a total employee estimate. In order to capture the contribution of firms still in operation only, survival rates were applied on the employment estimates. Thus, we estimate that the **300 start-ups** that have accessed Velocity’s services had an **employee headcount of 4,268** over the 2008 to 2018 period. To obtain revenue figures for these companies we have also used revenue to employment ratios for the High Tech industry from BC Stats.¹⁰² Based on this approach, we estimate total **spin-off revenues of \$1.3 billion** over the 2008 to 2018 period.

To obtain an estimate on the employment supported by the sample set of Accelerator Centre participants, Deloitte used available employment and survival rate data as follows¹⁰³:

- **Employment:** Internal data provided by the University indicated the total employment supported by Accelerator Centre programs since 2006.
- **Survival Rate:** According to internal University data, 93% of companies that have graduated from the core Accelerator Program are in operation after five years. It is assumed that this five year survival rate is indicative of firm survival over the 13 year period covered in our analysis (2006-2018).¹⁰⁴

Accordingly, we applied the survival rate on the total employment estimate to ensure we are only capturing the contributions of firms still in operation. Thus, we estimate that the Accelerator Centre’s **210 alumni companies** created **3,300 jobs** since 2006. Using revenue to employment ratios for the High Tech industry, we estimate total spin-off revenues of **\$1 billion** over the 2006 to 2018 period.

Sectoral and geographic distribution of companies assessed

In order to conduct our economic contribution analysis, spin-off activity needs to be segmented by industry and geography. Available University data on co-op work term placements and geography of spin-off companies were used to supplement our analysis.

In consultations with the University’s faculty, alumni entrepreneurs and graduates it was noted that experience in the Co-op program can often shape career choices after graduation. Since 2014/2015 the proportion of co-op students

⁹⁸ The categorization of a company as ‘growing’ was made by the University of Waterloo and taken to assume companies that are start-ups and growing. A standard definition of ‘growing’ includes characteristics such as the generation of a source of income and ability to take on customers. Cash flow should start to improve as recurring revenues help to cover the ongoing expenses and the profits should improve slowly and steadily. A Companies within the growing stage typically have a complete management team and the product or service has gone to market on a commercialized basis.

⁹⁹ Data provided on Velocity only captures employment information for a portion (16%) of all Velocity participants after they have exited the program via articles/updates.

¹⁰⁰ This figure is based on the average five year Velocity survival rates of 64% and 69% (which includes companies that were acquired).

¹⁰¹ It can be noted that the Velocity five year survival rate of 67% is in line with the five year survival rate of small businesses reported by Statistics Canada of 70% that is published within the 2019 edition of their Key Small Business Statistics publication.

¹⁰² BC Stats. Profile of the British Columbia Technology Sector: 2017 Edition.

¹⁰³ Detailed information on stage of development was unavailable for the sample set of companies from the Accelerator Centre measured herein

¹⁰⁴ It can be noted that the survival rate of Accelerator Centre participants of 93% surpasses the five year survival rate of small businesses reported by Statistics Canada of 70% that is published within the 2019 edition of their Key Small Business Statistics publication.

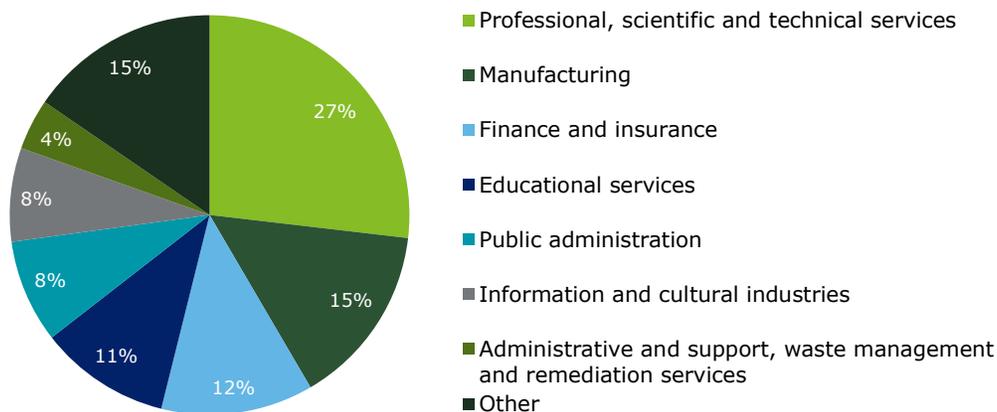
per semester per year is substantial and has risen from 68% in 2014/15 to 71% in 2018/19. Some programs are almost exclusively offered with the Co-op program¹⁰⁵.

- For example, students in engineering and architecture are automatically enrolled in the Co-op program.¹⁰⁶ Thus, our analysis assumes that Co-op work term industries are closely related to industry segments in which the University alumni have chosen to establish businesses.

Reviewing data on the distribution of Co-op work terms we find that it can be assumed that a majority of spin-offs are within the professional, scientific and technical services and manufacturing industries. Importantly, these sectors of the economy have significant technological applications. Accordingly, it is appropriate to assume that spin-off businesses will reside in manufacturing and service industries. We further analyze the sectoral distribution of companies by reviewing the results from the University’s Alumni Entrepreneurial Survey in 2015. Products related to the manufacturing industry includes advanced materials, information and communications technology, hardware, and sustainable technology.¹⁰⁷ While products related to service industry includes software, finance, telecommunications, publishing, energy, architecture and other business services.¹⁰⁸

The figure below provides an overview of the high level industry classifications for companies spun out of the University. As mentioned above, it is assumed that Co-op work term industries are closely related to industry segments in which the University alumni have chosen to establish businesses.

Figure 14: Distribution of Co-op work terms by Industry 2018/19



Source: University of Waterloo, 2017/18

Finally, we develop an assumption on the location of companies relevant to this analysis. The University of Waterloo is truly a global university with campuses and education centers on four continents, and academic partnerships spanning the globe. Similarly, the companies spun out of the university also have a global reach. Survey results from the University’s Alumni Entrepreneurial Survey¹⁰⁹ indicate that the majority of spin-off companies are headquartered within Canada (79%), while the remaining are based in the US (9%), and other countries (11%). Of the companies located within Canada, the majority are based in Ontario, with over half located in Waterloo region.¹¹⁰

4.6. Estimating the economic contributions of a sample of Velocity and Accelerator Centre companies

For the purpose of our analysis, we have excluded the economic contributions of spin-off companies based outside of Canada. Based on the assumptions described above, Deloitte has estimated that the sample set of Canadian-based companies that have graduated from Velocity and Accelerator Centre have made several important economic impacts including but not limited to:

¹⁰⁵ Deloitte Analysis

¹⁰⁶ University of Waterloo. Engineering. Web source: <https://uwaterloo.ca/engineering/future-undergraduate-students/co-op-experience>

¹⁰⁷ University of Waterloo (2016). Understanding Entrepreneurship among the University of Waterloo’s alumni.

¹⁰⁸ Ibid.

¹⁰⁹ Survey was sent out in 2015 and relevant for alumni graduating between 1960 to 2014

¹¹⁰ University of Waterloo Alumni Entrepreneurial Survey (provided by the University)

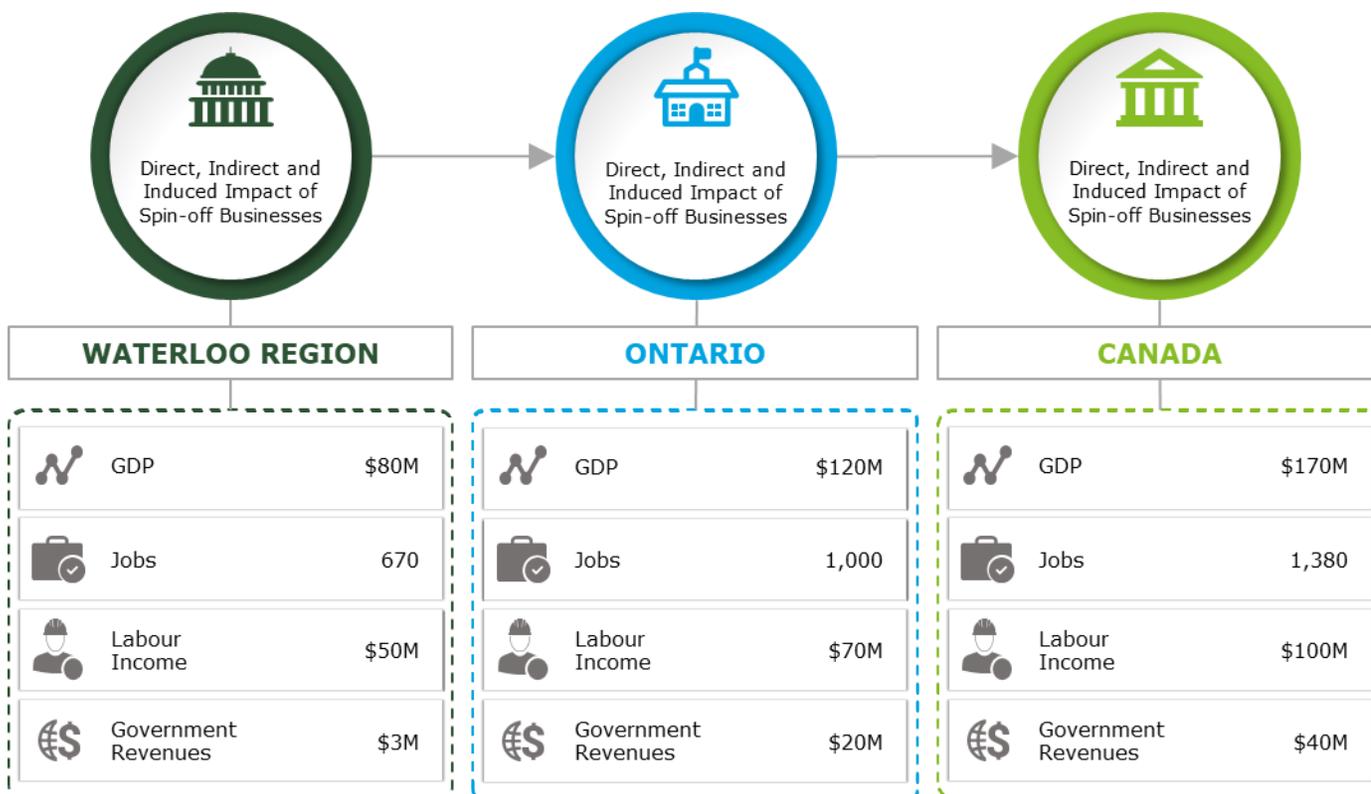
- Companies that have accessed Velocity services generated total spin-off revenues of **\$1 billion** over the 2008 to 2018 period or **\$94 million** in revenues annually
- Companies that have accessed Accelerator Centre services generated total spin-off revenues of **\$0.8 billion** over the 2006 to 2018 period or **\$62 million** in revenues annually

Key Component (Velocity)	Total Spin-off Revenues Generated (2008-2018)	Total Spin-off Revenues Generated (Annually)
Spin-offs based in Canada	\$1.0B	\$94M
Spin-offs based in US and Other Countries (excluded from analysis)	\$0.3B	\$25M
Total (included in analysis)	\$1.0B	\$94M

Key Component (Accelerator Centre)	Total Spin-off Revenues Generated (2006-2018)	Total Spin-off Revenues Generated (Annually)
Spin-offs based in Canada	\$0.8B	\$62M
Spin-offs based in US and Other Countries (excluded from analysis)	\$0.2B	\$16M
Total (included in analysis)	\$0.8B	\$62M

To communicate an estimation of economic impacts, we will use annual figures with the aim of providing point-in-time estimates of the economic contribution of spin-off businesses in 2018/2019. The revenue values for spin-offs based in Canada that have accessed Velocity and Accelerator Centre services were applied against Statistics Canada input-output multipliers to obtain economic contribution estimates as summarized below.

Figure 15: Direct, Indirect, and Induced Economic Contributions of a sample set of companies that have spun out Velocity and the Accelerator Centre, 2018/19.



For a breakdown of economic contribution by direct, indirect and induced impacts please refer to Appendix D

4.7. Summary of the economic contributions of businesses that have spun out of Velocity and the Accelerator Centre

The annual economic contributions of businesses that have spun out of the University are estimated to be as follows:

- **Local Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that spin-off businesses contributed approximately **\$80 million** to the local GDP, of which comprised **\$50 million** in labour income and created or sustained **670** full-time equivalent (FTE) jobs across the Waterloo region and added **\$3 million** to the region's government revenues.
- **Provincial Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that spin-off businesses contributed approximately **\$120 million** to Ontario's GDP, of which comprised **\$70 million** in labour income and created or sustained **1,000** full-time equivalent (FTE) jobs across Ontario and added **\$20 million** to Ontario's government revenues.
- **National Impact:** Accounting for the direct, indirect and induced impacts, it is estimated that spin-off businesses contributed approximately **\$170 million** to Canada's GDP, of which comprised **\$100 million** in labour income and created or sustained **1,380** full-time equivalent (FTE) jobs across Canada and added **\$40 million** to Canada's government revenues.

4.8. Limitations of the economic contribution analysis of businesses that have spun out from the University of Waterloo

Due to a lack of sufficient data our analysis cannot fully estimate the degree to which a spin off company's existence was influenced by the University. Typically, spin-off attribution rates to the University vary between high and low levels of attribution.

These estimations also approximate the economic contributions of a sample set of companies that could be attributed to the University of Waterloo. Given data availability limitations, companies founded by University of Waterloo alumni that did not access Velocity or Accelerator Centre programming are not captured in the analysis herein and thus our figures does not capture the total number of firms (and their corresponding economic contributions to the economy).

4.9. Examining Venture Capital characteristics of University of Waterloo founded companies

Another lens through which the University's contributions to supporting entrepreneurship can be analyzed is through Venture Capital (VC) patterns amongst University of Waterloo founded-companies. For entrepreneurs, accessing VC can be a significant milestone. VC investment provides firms with capital, strategic assistance, and introductions to potential customers, partners and employees. Typically, VC funds invest in startup and small to medium sized enterprises with strong growth potential.^{111 112} Importantly, VC investment decisions are based on quantifiable evidence of potential success – including the presence of a high quality business prospectus and an assessment of a company's alignment to broader market size, competitive advantages, macroeconomic and demographic trends, and regulatory or legal compliance ¹¹³ There is evidence that the University of Waterloo founders have been able to access this important milestone.

- **University of Waterloo produces the largest number of VC backed entrepreneurs in Canada:** In 2018-19, Pitchbook ranked the University of Waterloo 1st amongst Canadian peers in the number of VC-backed entrepreneurs and 21st in the world. While McGill University is ranked 2nd amongst Canadian peers and 29th in the world. Followed by the University of Toronto, ranked 3rd in Canada and 32nd in the world.¹¹⁴
- **University of Waterloo surpasses peers in the amount of VC raised by alumni:** Pitchbook has identified at least 408 entrepreneurs and 314 companies that were founded by University of Waterloo graduates over the 2006-2018 period.¹¹⁵ These spin-offs were identified to have raised \$7.36 billion in North American VC over this period. While over the same time period, McGill University's 330 entrepreneurs and

¹¹¹ Investopedia. 2019. Venture Capital Funds. Web source: <https://www.investopedia.com/terms/v/vcfund.asp>

¹¹² Ibid.

¹¹³ Investopedia. 2018. How Venture capitalists make investment choices. Web source: <https://www.investopedia.com/articles/financial-theory/11/how-venture-capitalists-make-investment-choices.asp>

¹¹⁴ Pitchbook. 2019. PitchBook Universities: 2018-2019 Edition. Web Source: https://pitchbook.com/news/reports/2018-pitchbook-universities-2018-2019-edition?utm_medium=nl-na&utm_source=reports&utm_campaign=2018-2019-universities

¹¹⁵ Ibid.

304 companies raised \$7.06 billion in VC and the University of Toronto's 321 entrepreneurs and 285 companies raised \$6.57 billion in VC.

Each instance in which a University of Waterloo founded company is successfully able to access VC is important, as accessing VC can be challenging, and often out-of-reach for start-ups. Recent analysis of Canada's VC market reveals that Canadian companies often take an average of one to two years longer to receive funding after their founding than their U.S counterparts. Canadian VC investors can also demand to see more progress from a company before extending a first round of financing than their U.S. colleagues.¹¹⁶

In addition, accessing VC in Canada can be particularly challenging as the average Canadian fund size is \$111 million (in contrast to \$172 million south of the border). Smaller funds can write smaller cheques, leading to their portfolio companies to operate in a capital constrained environment. In fact, Canadian companies only raise half as much capital on average over their lifetimes as their U.S. peers¹¹⁷.

4.10. The economic benefits of entrepreneurship

Taken together, the businesses that have spun out of the University of Waterloo are a significant contributor to the Canadian economy. In a knowledge-based society, innovation is the driving force of economic development. The technologies and innovations spurred by the University's spin-off companies provide job opportunities and help to advance the standard of living for all Canadians. Key economic benefits to entrepreneurship include:

- **Supporting Industry 4.0:** Our analysis assumes companies that have spun out of the University are related to high-technology segments of the economy that can drive important impacts to society and the economy.¹¹⁸ Increasingly, high-technology companies are combining and contributing to 'Industry 4.0' – a phase of the economy in which economic growth is supported by the application of smart/digital technologies to enhance productivity. High-technology firms are able to develop cross-cutting capabilities that can significantly improve productivity and enhance our quality of life by creating faster, more flexible, and more efficient processes to produce higher-quality goods at lower costs.
- **Job creation:** First and foremost, companies that spin out of the University are able to create new job opportunities in Canada and around the world. These jobs can increase the standard of living for individuals and their families and allow previously unemployed or underemployed workers to increase take-home pay and better meet financial obligations. Deloitte estimates that each spin-off company described in our analysis above employs approximately two direct FTEs annually.¹¹⁹ While this number is modest, it is in line with the Canadian business sector, where 53.8% of Canadian companies across all industries employ between one and four employees.¹²⁰
 - Additionally, the characteristics of the companies we have estimated to have spun out of the University also align to some attributes of 'high growth' firms in Canada. Policy makers typically identify high-growth firms as innovative high-tech firms.¹²¹ These firms are similar to those we assume have spun out of the University given that these spin-off firms typically specialize in technological applications within the manufacturing and services industries.
 - High-growth firms can have unique impacts to the economy. The majority (63%) of net employment change between 2009 and 2012 in Canada was driven by high growth firms. Notably, 35% of high growth firms were identified as micro-enterprises (with one to four employees)¹²² thereby having employment footprints similar to the companies that we have estimated to spun out of the University.
- **Increased spending:** Jobs created or retained by companies that have spun out of the University can support higher overall spending in the economy, and increased employee earnings could potentially lead to a

¹¹⁶ Canada's Venture Capital Landscape: Challenges and Opportunities. June 2017

¹¹⁷ Ibid

¹¹⁸ The High Tech industry, as defined by BC Stats, encompasses firms that tend to be innovative and efficient, producing goods and services that drive economic growth and provide relatively high-wage employment.

¹¹⁹ This figure was estimated by dividing the direct FTEs job estimate at the national level by the corresponding number of companies that accessed Velocity and Accelerator Centre services. For example, the Velocity averages of between 4 and 41 employees are point in time estimates over the 2008-2018 period. However, as described in the report only 67% of these companies survive after five years. Thus, the total estimated employment supported by the 300 Velocity firms is 3,380 employees over the 2008-2018 period. If we divide this employment number (3,380) over the number of years (11) and number of companies (300) this covers, it is estimated that each Velocity company supports the employment of 1 FTE annually.

Moreover, if we include our employment estimate supported by the Accelerator Centre annually, we then derive our total estimate of 2 FTEs annually.

¹²⁰ Statistics Canada. 2019. Key Small Business Statistics – January 2019. Web Source: : https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03090.html

¹²¹ Innovation, Science and Economic Development Canada (2017). The Contribution to Canadian Net Employment Change by High-Growth Firms. Web Source: [https://www.ic.gc.ca/eic/site/061.nsf/vwapj/CCNEC_HGF-EFC_CCNEC_2017_eng.pdf/\\$file/CCNEC_HGF-EFC_CCNEC_2017_eng.pdf](https://www.ic.gc.ca/eic/site/061.nsf/vwapj/CCNEC_HGF-EFC_CCNEC_2017_eng.pdf/$file/CCNEC_HGF-EFC_CCNEC_2017_eng.pdf)

¹²² Ibid.

higher rate of consumer spending, which benefits other businesses who depend on consumer sales to stay open and pay vendors.

- **Development of new products and services:** By increasing number of firms in the economy, new products and services can be generated that can be adopted by companies and people to improve their day-to-day life and quality of life. Over time, this can contribute to valuable increases in productivity across industries and support a better standard of living.

Taken together, the University's ability to support entrepreneurship through several channels elevates its importance to the economy and can be seen in different ways. The companies that have spun out of the University can grow to be employers thereby driving investment within the economy.

5. The Economic Contributions and Benefits of the University's Research Activities

5.1. Characterizing the University of Waterloo's research activities

Entrepreneurship and innovation go hand-in-hand. Innovation has always been one of the main objectives of the University, as the founders of the University prioritized innovation and technological training as the channel to solve the world's future challenges. The University has stated a goal to be recognized as one of the top innovation universities in the world. On the journey to this goal, the University has made several choices and investments that not only enhance its own innovation capacity – but have important economic benefits that can be seen regionally, provincially and at the national level.

Analogous to the University's ability to support entrepreneurship, characterizing the economic benefits of the University's research activities can be done in several ways. In this chapter, we apply both a quantitative and qualitative lens to demonstrate how the University is able to contribute meaningful economic impacts through its research activities, as seen in the following frames:



- Characterizing the University's world-class research talent



- Evaluating the economic contributions of the University of Waterloo's 2017/2018 research expenditures



- Characterizing the University's suite of dedicated research institutes



- Highlighting the University's participation in research partnerships



- Demonstrating the University's supports of the adoption of new technologies in Canada

5.2. Characterizing the University of Waterloo's research talent

The University of Waterloo has been named Canada's most innovative university for the last 27 years running, according to a reputation survey from MacLean's Magazine¹²³. This reputation is a reflection of the University's superior ability to foster the development of new technologies, and the presence of world-class experts in fields across areas of study. The strength of the University's researchers can be demonstrated by the high volume of awards received by granting council. Among Ontario's six most research intensive universities, the University of Waterloo was ranked 2nd in terms of number of research awards by granting council with 1,554 in 2017.¹²⁴ These

¹²³ Most Innovative University, 27 Years Running. Web Source: <https://uwaterloo.ca/computing-financial-management/news/most-innovative-university-27-years-running>

¹²⁴ CUDO. 2017. Research Awards, by Granting Council. Web Source: <https://cudo.ouac.on.ca/>

awards provided approximately \$70 million in funding (the third highest among the six most research-intensive universities in Ontario) in 2017.¹²⁵ The impact of the University's faculty is significant:



Several of the University's faculty have been internationally recognized for their notable contributions to the fields of their study, thereby putting the University on the map globally.



Case study: Donna Strickland

Donna Strickland exemplifies the University's research excellence. Dr. Strickland is a Professor in the Department of Physics and Astronomy and was awarded the Nobel Prize in 2018 in physics for her advances in chirped pulse amplification technique, described by the academy as generating high-intensity, ultra-short optical pulses. The technique now has broad applications, including use in corrective laser eye surgery¹²⁶. She shares one half of this year's prize with Gérard Mourou of France, for their work on high-intensity lasers. American physicist Arthur Ashkin will receive the other half of the award. Strickland has been teaching at the University since 1997 and oversees an ultra-fast laser lab. Her research is an example of fundamental research that provides a foundation for interdisciplinary approaches.

Donna Strickland, University of Waterloo professor and recipient of the 2018 Nobel Prize in Physics

The University leverages its world class talent in unique ways by intentionally choosing to address some of society's most complex challenges and opportunities by working across Faculties and fields of study. In consultations with research leaders at the University, the University's ability to foster an open, collaborative environment that encourages researchers to connect with each other across fields of study is viewed as a critical contributor to the University's research excellence. The University's research community often comes together across Faculties in cross-disciplinary research projects, initiatives and course offerings. Importantly, several of these cross-disciplinary research initiatives are targeted towards advancing research and scholarship to some of society's most complex challenges and opportunities.

For example, the University of Waterloo's commitment to sustainability research is deeply embedded across six University Faculties and includes more than 260 faculty members conducting research related to topic areas such as water, renewable energy, climate change, transportation and ecological systems. The Faculty of Environment, one of the lead centers of sustainability research was one of the first of its kind in Canada. It has consistently produced high-quality research and graduates needed to address complex environmental issues. The University also hosts more than

¹²⁵ Ibid.

¹²⁶ University of Waterloo Scientist First Woman to Win Nobel Prize in Physics in Decades. Web Source: <https://www.therecord.com/news-story/8941461-university-of-waterloo-scientist-first-woman-to-win-nobel-prize-in-physics-in-decades/>

540 courses that focus on or include sustainability, ensuring graduates from many programs understand the sustainability challenges they will inevitably face in the working world.

An interdisciplinary approach to research can create the conditions for positive research outcomes by making research relevant to a wider audience of experts and readers and enabling researchers to draw from a broader base of scholarship to develop explanations or predictions. In addition, an interdisciplinary approach to research can help inspire researchers to confront dimensions of problems that may otherwise not be focused on (i.e. the unintended societal consequences of climate change).

5.3. Evaluating the economic contributions of the University of Waterloo's research expenditures

Research is a critical component to economic growth as it can drive increases in productivity. Research activities performed at universities support technological advancement, leading to creation of new or improved processes and products that increase efficiency in our day-to-day lives. For example, artificial intelligence is being applied across the economy from new ways of detecting cancer to empowering self-driving vehicles. Over time, as productivity increases, and new products and processes are adopted – our quality of life can improve.

Educational institutions are a significant driver of research and development activities. In 2017, the higher education sector performed 41% of all research and development activities in Canada.¹²⁷ The University of Waterloo's research expenditures represent 7% of all universities' sponsored research expenditures in Ontario in 2017-2018.¹²⁸ In this regard, compared to the six universities in Ontario that are part of the U15, the University ranks fifth.¹²⁹ While the University of Waterloo has a modest share of total sponsored research expenditures, it is important to note that it is the only university without a faculty of medicine – typically a major source of research expenditure.

The University of Waterloo's research success can be communicated in several ways, such as through the number of research publications it produces. Another dimension of research success is also the extent to which a university is able to attract additional investment in research from public and/or private partners. In this regard, the University of Waterloo has attracted funds and invested significantly in its research activities. In 2017-2018, the University spent more than \$192 million on sponsored research, with funds coming from public and private sources to fund research across a spectrum of research initiatives.¹³⁰

Our approach to quantifying the economic contributions of research expenditures

The University of Waterloo's research activities are an integral dimension to its contributions to the economy and can be estimated. Our estimation of the economic impact associated with the University's research activities evaluates research expenditures and their impact on Ontario's GDP. We have designed our methodology by conducting a literature review of existing approaches to estimating research related economic contributions in Canada used by other universities.

Our literature review revealed that several Canadian universities have leveraged methodologies developed by Fernand Martin in 1998 and Walter Sudmant in 2009 which estimates the impact of university research expenditures by calculating the share of total factor productivity (TFP) or multifactor productivity (MFP).^{131,132} TFP or MFP is the portion of output not explained by the amount of inputs used in production that could be attributed to a university's research expenditure.

Unlike an economic model based on input-output multipliers which measures static contributions, Martin and Sudmant's approach is dynamic and allows us to take into account spillover impacts of knowledge created by a university on labour and capital productivity. In our analysis, TFP or MFP was deemed an appropriate metric to analyze research contributions because it measures the change in GDP associated with labour productivity growth that cannot be explained by changes in capital intensity or labour composition.

Both approaches estimate the economic contributions of university research expenditure to the economy. However, Martin estimated the impacts of research expenditure of all Canadian universities to Canadian GDP. In contrast,

¹²⁷ Statistics Canada. Table 27-10-0273-02 Expenditures on research and development (R&D) by performing sector (x1,000,000). Extracted August 15, 2019 from: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2710027302>

¹²⁸ CAUBO. 2019. Financial Information of Universities and Colleges. Web Source: https://www.caubo.ca/wp-content/uploads/2019/07/CAUBO_2017-2018_Financial-Information-of-Universities-and-Colleges.pdf

¹²⁹ Ibid.

¹³⁰ Ibid.

¹³¹ Martin, F. 1998. The economic impact of Canadian university R&D. Research policy, 27(7), 677-687.

¹³² Sudmant, W. 2009. The Economic Impact of the University of British Columbia. Web Source: https://president.ubc.ca/files/2013/02/economic_impact_2009.pdf

Sudmant, estimated the economic contribution of only one university to the provincial GDP. Our analysis leverages this work to estimate the contributions from the University of Waterloo’s research expenditures on Ontario GDP only.

In order to capture more current economic conditions, Deloitte modified and tailored Martin and Sudmant’s methodology in the following ways:

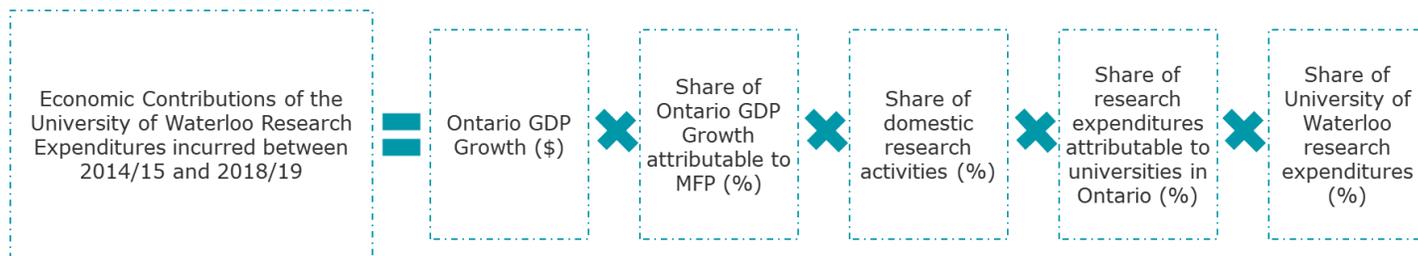
- The assumptions originally proposed by Martin (1998) were for the 1971-1993 period. In order to reflect the University of Waterloo’s contributions to the Ontario economy in a more recent time frame, we chose to conduct our analysis on the economic contributions in 2018/19 of research expenditures incurred between 2014/15-2018/19.
- As a result of this updated time period, we correspondingly adjusted the inputs of the model to reflect the composition and performance of the Ontario economy between 2015-2019 (i.e., updates of average MFP, estimates of GDP growth in Ontario, and share of research undertaken by the higher education sector in Ontario within the time period).

Our methodology intentionally analyzes the economic contributions of historical expenditures conducted in a reference period of the years 2014/15-2018/19 to Ontario’s GDP in 2018/19 due to the dynamic nature of research expenditures’ impacts to the economy. The economic benefits of research activities can often be realized by the economy years later. For example, the knowledge and discovery created by university research expenditures can spill over to the economy through various mechanisms, such as the creation of new companies, or the adoption of patented technologies by private companies. Thus, research expenditures can impact the economy on a long term basis in a recurrent manner, exceeding the year of the activity.^{133,134}

Research projects can also have long term horizons and can be phased over many years. In some cases, it can take years for research that is available in the public domain or via intellectual patent to be adopted and/or commercialized. Accordingly, our methodology estimates impacts on Ontario’s GDP in 2018/19 for research activities undertaken in 2014/15-2018/19.¹³⁵

This methodology is summarized in the figure below:

Figure 16: Overview of Methodology to Estimate University of Waterloo Research Expenditures



For a detailed overview of our methodology, please see Appendix C.3

A summary of the analysis taken to determine each input into this calculation is presented below:¹³⁶

Estimating Ontario GDP Growth: Using GDP yearly data obtained from Statistics Canada, and the computation of GDP growth as presented by Martin (1998), we found the increase in GDP dollar value over the 2015 and 2019 time period.

¹³³ Soete, L.L., Verspagen, B., & Ziesemer, T. H. (2019). The productivity effect of public R&D in the Netherlands. *Economics of Innovation and New Technology*, 1-17

¹³⁴ Guellec, D., & De La Potterie, B.V.P. (2002). R&D and productivity growth. *OECD Economics Studies*, 2001(2), 103-126

¹³⁵ Deloitte Access Economics. 2015. The economic contributions of Australia’s research universities The UNSW example. Web Source: <https://www2.deloitte.com/au/en/pages/economics/articles/economic-contributions-australias-research-universities-unsw.html>

¹³⁶ While the University’s data and financial information are presented by fiscal year, the data from Statistics Canada was only available by calendar year. To insure consistency throughout the report, our analysis assumes there is no difference between the two.

Estimating the GDP growth attributable to MFP gains: Using data obtained from Statistics Canada, 23% of GDP growth was attributable to MFP gains over the 2013 to 2017 time period.^{137 138}

Calculating the share of domestic research activities: MFP in the Canadian economy can grow due to a combination of global and Canadian research activity. For example, innovation in another country could be adopted within Canada and drive increases in labour productivity. For the purposes of this study, we want to focus on gains in MFP attributed to domestic research activities only. This approach ensures that the analysis presented herein could be attributed in some way to the University of Waterloo. We estimate the domestic share of MFP to be 69% as determined by Martin (1998).

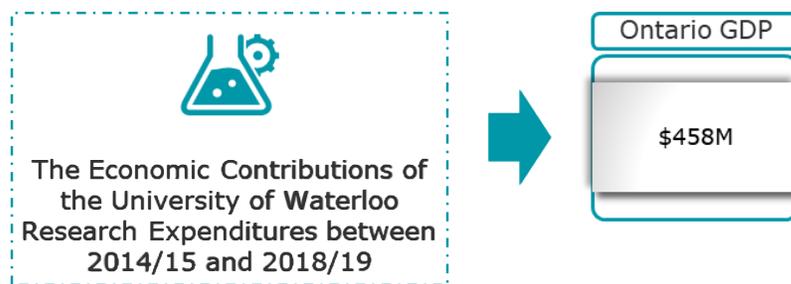
Estimating the share of research expenditures attributable to universities in Ontario: Research activities are performed across the economy, including by private businesses and government. In order to determine the share of total research expenditures attributable to universities only, we reviewed Statistics Canada data from 2012 to 2016 (the most recent publically available data) to identify that approximately 36% of research expenditures are attributable to Ontario universities relative to other parts of the provincial economy.¹³⁹

Estimating the share of University of Waterloo research expenditures in Ontario: Based on a review of Canadian Association of University Business Officers data for 2017/2018 (the most recent publically available data), we identified the total sponsored research expenditures for all universities and colleges in Ontario.¹⁴⁰ Using this data, we estimated that the University of Waterloo is responsible for 7% of the total sponsored research expenditures done by universities in Ontario.¹⁴¹

5.4. Summary of Economic Contributions from University of Waterloo Research Expenditures

Using the methodology outline above, Deloitte estimated the total impact of the University of Waterloo’s research expenditures. Thus, we estimate that the total impact of research activities executed from 2014/15-2018/19 funded by the University on Ontario’s GDP reached \$458 million in 2018/19. This methodology accounts for the fact that research undertaken in previous years can have economic benefits that are realized in the economy years later.

Figure 17: Research Expenditure Contribution to Ontario GDP in 2018/19 for Research Activities Undertaken between 2014/15 and 2018/19 by the University of Waterloo



In summary, universities facilitate knowledge transfer by publishing their research findings in academic journals or by exchanging with public and private institutions. Their research findings impact processes, products and services offered in various industries, allowing for more efficiency at different levels of the supply chain. Our analysis reveals that the University’s research expenditures incurred between 2014/15 and 2018/19 had a significant economic impact on the province of Ontario. It highlights that the research done by the University stimulates the Canadian economy by supporting innovation and productivity.

¹³⁷ Deloitte Analysis & Statistics Canada. 2019. Table 36-10-0208-01 Multifactor productivity, value-added, capital input and labour input in the aggregate business sector and major sub-sectors, by industry. Web Source: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610020801>
¹³⁸ Due to a lack of more recent data, our analysis approximates GDP growth attributable to MFP gains over a five year period using data available from 2013 to 2017.
¹³⁹ Deloitte Analysis & Statistics Canada. 2019. Table 27-10-0273-02 Expenditures on research and development (R&D) by performing sector (x 1,000,000). Web Source; <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2710027302>
¹⁴⁰ CAUBO does not provide a detailed definition of sponsored research.
¹⁴¹ CAUBO. 2019. Financial Information of Universities and Colleges. Web Source: https://www.caubo.ca/wp-content/uploads/2019/07/CAUBO_2017-2018_Financial-Information-of-Universities-and-Colleges.pdf

Limitations of quantifying the economic contributions of research expenditure

Our estimation may not fully capture the total contribution of research expenditures as research findings could become publicly available and leveraged for other activities that could drive economic contributions not captured herein (e.g., additional discovery, the patenting of products and services).

As the domestic share of MFP attributable to domestic research activities was estimated in 1993, it is possible the share in today's economy may be different. For example, the economy has changed significantly since the publication of Martin's analysis with transformative forces such as globalization and disruptive technologies changing productivity in the economy.

In addition, economic contributions in Ontario will have an impact to Canada's GDP. However, impacts to Canadian GDP have not been estimated so as to remain consistent with the approach undertaken by other peer universities that have leveraged Martin and Sudmant.

Our analysis assumes a standard return profile for the research expenditures undertaken by the university. Detailed information on the type, scope, sector or relative success of research activities that correspond to the expenditures between 2014/15-2018/19 was not available. International research partnerships or initiatives may not be captured within our analysis as detailed information was not available.

Additionally, it is likely that research undertaken by the University could have been leveraged by companies that have spun out of the University. However, there is a lack of available and/or complete data that provides insights on the extent to which the research activities referenced in this report could be attributable to spin-off company creation. Thus, in absence of this data, economic contribution results of research expenditure should be considered discretely from economic contribution estimates of companies that have spun-out of the University in Chapter 4.

Finally, our analysis is point-in-time only and looks at contributions to Ontario's GDP in 2018/19 only. It is possible that the activities related to research expenditures evaluated herein may have a different profile of impacts in other years not analyzed. The five year time period chosen can also not fully capture the economic contribution of research activities given the length of time that it takes for research outputs to be published, used and incorporated. Similarly, our estimation of economic contributions in 2018/19 may reflect the contributions of research activities undertaken prior to the study time period (e.g., 2009).

Additional examples of the University of Waterloo's research activities

In addition to the aforementioned economic contributions from research expenditures, the University further supports the economy by providing capital for Canadian researchers to interact with, and collaborate with the global research community. For example, the International Research Partnership Grants (IRPG) are internal seed grants that provide Waterloo researchers with incentives to develop new or existing international research collaborations with leading institutions known for high-quality research and global ranking. Since 2011, 134 projects have been funded totaling \$1.9 million that garnered \$2.9 million in matching cash contributions and subsequently generated over \$18 million in new grants awarded to Waterloo researchers. These projects have also resulted in 58 new innovations, four patents and five startups. Aimed at developing new and existing international research collaborations for Waterloo researchers, the program awards funding twice a year.

In addition, University faculty have successfully been able to attract funding for research from outside of Canada. For example, Dr. Brian Dixon is leading a team of researchers to develop treatments for infections in fish and shrimp aquaculture. The team has been awarded funding through the InnoVet-AMR program, a partnership between Canada's International Development Research Centre (IDRC) and the United Kingdom's Department of Health and Social Care (DHSC) to reduce the misuse of antimicrobials in animal production in the Global South. Taken together, the University's ability to enhance the level of capital available to fund research in the Canadian research ecosystem can enable the discovery of new innovations.

5.5. Characterizing the University's dedicated research institutes

The University has invested in over 30 dedicated research centers and institutes with expertise on specific areas of study. These centers create a cluster of research excellence that can contribute to Canada's innovation competitiveness by advancing game-changing fundamental and applied research. Dedicated research facilities are

uniquely able to attract, retain and train researchers from around the globe and foster collaboration across various sectors¹⁴².

The University is home to over 30 dedicated research centers and institutes with world-leading expertise in fields such as:

 <p>Artificial Intelligence</p> <ul style="list-style-type: none"> • The AI Institute • The Cybersecurity and Privacy Institute 	 <p>Automotive</p> <ul style="list-style-type: none"> • Waterloo Centre for Automotive Research (WatCAR) 	 <p>Cybersecurity and Privacy</p> <ul style="list-style-type: none"> • Cybersecurity and Privacy Institute (CPI) 	 <p>Energy</p> <ul style="list-style-type: none"> • Interdisciplinary Centre on Climate Change (IC3) • Waterloo Institute for Sustainable Energy (WISE) • Water Institute
 <p>Global Governance</p> <ul style="list-style-type: none"> • Global Health Policy & Innovation Research Centre (GHPI) • Centre for International Governance 	 <p>Nanotechnology</p> <ul style="list-style-type: none"> • Waterloo Institute for Nanotechnology (WIN) 	 <p>Bioengineering and Biotechnology</p> <ul style="list-style-type: none"> • Centre for Bioengineering & Biotechnology (CBB) 	 <p>Quantum Information</p> <ul style="list-style-type: none"> • Institute for Quantum Computing (IQC)

Case Study: Institute of Quantum Computing

Quantum computers and related technologies can be expected to lead the next industrial super cycle.¹⁴³ The Institute for Quantum Computing (IQC) is dedicated to advancing scholarship in this regard. The Institute is a scientific research institute focused on using quantum laws to develop new technologies and is world leading in its field. The Institute can be considered a global research asset based on several elements including:

Execution of ground breaking research: Quantum computing is a platform of fields that can combine to create the next generation of computing, sensing and communication technologies including areas such as quantum cryptography, quantum radar, quantum sensors, quantum materials and error correction in quantum computers. The Institution is home to state-of-the-art laboratories that can enable this type of research that are globally leading.

- Michael Reimer, an IQC member and assistant professor in the University's Faculty of Engineering is working on a quantum sensor able to capture high-resolution 3D images that could improve cancer treatment¹⁴⁴.



Mike & Ophelia Lazaridis Quantum-Nano Centre

¹⁴² Canada Foundation for Innovation. Conversation on the Future of Research Infrastructure in Canada: Role of the Canada Foundation for Innovation. A Discussion Paper. November 2018

¹⁴³ The Record. 2018. Quantum computers and related technologies can be expected to lead the next industrial super cycle. Web Source: <https://www.therecord.com/news-story/8754008-kitchener-startup-claims-quantum-computing-breakthrough/>

¹⁴⁴ University of Waterloo. 2019. New quantum sensor could improve cancer treatment, long range 3D imaging. Web Source: <https://uwaterloo.ca/institute-for-quantum-computing/news/new-quantum-sensor-could-improve-cancer-treatment-long-range>

Case Study: Institute for Quantum Computing cont'd

An anchor for Canada's 'Quantum Valley': Since the founding of the institute in 2002, several quantum computing companies have spun out of the Institution or chosen to locate close to the facility. The region is home to a "complete theory to commercialized ecosystem" that has contributed to a concentration of expertise in quantum computing and has developed in the region earning the moniker of 'Canada's Quantum Valley' with the Waterloo region now one of the leading centers for quantum research in North America¹⁴⁵.

- Specifically, the Institute has been accredited to supporting the development of a concentration of the 'Quantum Workforce' in Waterloo which has attracted a "critical mass of talented researchers" from around the world¹⁴⁶.
- Out of recognition of this potential area of competitive advantage, the Canadian government invested \$41 million in Waterloo-based quantum technology businesses to build on the region's reputation as a leader in quantum technology and research.

Partnering with the ecosystem: The IQC does not operate in isolation. Instead, the institute is an active partner with other nodes of innovation across the country - thereby extending its significance. For example the Institute provides meaningful resources to industry through allowing companies to use a fabrication lab where quantum computer chips, materials and sensors can be made. IQC businesses partners can access the lab and what's made there to gain a potential business advantage in their work. Recently, this approach helped build and launch the first quantum satellite¹⁴⁷.

In the coming years, IQC will reach its projected complement of 30 faculty members, 50 postdoctoral fellows and 125 students. With IQC as a world-leader in quantum information research, with the University contributing to Canada's growing strength in this technology area and a key hub for the next information revolution¹⁴⁸.

Case Study: Interdisciplinary Centre on Climate Change

The Interdisciplinary Centre on Climate Change or IC3 is an interdisciplinary research institution at the University of Waterloo focused on climate change research and education¹⁴⁹.



Finding innovative solutions to a global challenge: Climate change is one of society's biggest challenges. The effects of Climate Change on the environment are becoming more visible, with rising sea levels, heavy downpours and heatwaves affecting the world's population. As governments and organizations are looking for solutions to slow down climate change and protect their population from its effects, members of the IC3 are focusing their research on supporting society's transition to more sustainable practices. The IC3's members are contributing to high quality research with over 600 peer-reviewed publications published between 2008 and 2014 and contributions to 80 books and book chapters in the same period¹⁵⁰.

- Dr. Daniel Scott, the IC3 executive director is pioneering important research with the World Meteorological Organization,¹⁵¹ and has led a team for the United Nations World Tourism Organization, estimating the GHG emissions associated with the tourism sector. This research is being used as the baseline for their policy goals.

An interdisciplinary approach to improve outcomes: The burdens associated with climate change are affecting all strata of the society, requiring action from political leaders and private and public organizations in every field. An interdisciplinary approach allows for solutions that are more readily adopted and more efficient. The University's IC3 includes members from 18 departments, three on-campus climate research groups and five external organizations.

¹⁴⁵ Quantum Technology. Waterloo EDC. Web Source: <https://www.waterlooeedc.ca/en/industries/resources/Waterloo-EDC-Quantum-Technology-Feature-Sheet.pdf>

¹⁴⁶ Waterloo very much in the game in quantum computing game. Web source: <https://www.therecord.com/news-story/9121482-waterloo-very-much-in-the-game-in-quantum-computing/>

¹⁴⁷ Ibid.

¹⁴⁸ University of Waterloo. 2019. Institute for Quantum Computing. Web source: <https://uwaterloo.ca/institute-for-quantum-computing/about>

¹⁴⁹ University of Waterloo. 2019. About the Interdisciplinary Centre on Climate Change (IC3). Web Source: <https://uwaterloo.ca/climate-centre/about>

¹⁵⁰ University of Waterloo. 2019. About the Interdisciplinary Centre on Climate Change (IC3). Web Source: <https://uwaterloo.ca/climate-centre/about>

¹⁵¹ University of Waterloo. 2019. Daniel Scott. Web Source: <https://uwaterloo.ca/scholar/dj2scott/home>

Case Study: Interdisciplinary Centre on Climate Change cont'd

- For example, Dr. Jason Thistlewaite (Environment) and Dr. Daniel Henstra (Political Science) are conjointly researching flood risk in Canada¹⁵². This research is particularly important for officials and individuals to ensure flood prevention, which can cost millions to Canada every year.

Importantly, these research institutes are assets for the broader regional economy. Economic development stakeholders identified the presence of institutions as a key pull factor in supporting inward investment as companies have chosen to specifically choose to invest in the community to collaborate in shared research initiatives.

5.6. Demonstrating the University's supports of the adoption of new technologies in Canada

Increasingly, academic settings have become hosts for research done in partnership with global institutions, private companies and research consortia. The University of Waterloo has a plethora of partnerships across partner types.

International partnerships

One in five of the world's scientific papers are co-authored internationally. As a result, ensuring Canadian researchers are able to access global research partnerships can be viewed as a mechanism through which the conditions for innovation can occur. As a result of the expansion of communication methods and the ease of international travel, academics and researchers are finding it easier than ever to collaborate with their foreign counterparts, making the exchange of academic ideas much simpler to organize¹⁵³.

The University of Waterloo has taken advantage of these opportunities and has over 150 research-based agreements with institutional partners in 42 countries¹⁵⁴.

Key examples include:

- The Waterloo Institute for Sustainable Energy partnered in 2015 with the Karlsruhe Institute of Technology in Germany to form the Affordable Energy for Humanity Global Change Initiative or AE4H. With now over 150 members from 50 institutions, the AE4H gather meetings, and conduct joint projects aimed at ending energy poverty through the sustainable deployment of clean energy¹⁵⁵.
- The Waterloo Institute for Nanotechnology has agreements with three of India's top institutions, through which it is funding researchers and students exchanges between the Institute and India's Nano Mission¹⁵⁶. The research ranges from "Nanoparticles for Targeted Cancer Therapy" with the Indian Institute of Technology to "Smart Tattoo Glucose Sensors".

Importantly, these forms of partnership can help enhance the ability of the Canadian research community to integrate globally as shared initiatives can provide a channel through which to develop cultural awareness and exposure.

¹⁵²In the media: IC3 Members' research on flood risk maps & climate change. Web Source: <https://uwaterloo.ca/climate-centre/news/media-ic3-members-research-flood-risk-maps-climate-change>

¹⁵³ Why are International Collaborations so Important for Universities? QS. Web Source: <https://www.qs.com/why-are-international-collaborations-so-important-for-universities/>

¹⁵⁴ Support for Researchers. Web Source: <https://uwaterloo.ca/international/research/support-researchers>

¹⁵⁵ AE4H. 2019. Web source: <https://ae4h.org/>

¹⁵⁶ University of Waterloo. 2019. India. Web Source: <https://uwaterloo.ca/institute-nanotechnology/partnership-and-collaboration/international/india>

Corporate research partnerships

For several years, large companies have been adopting a policy of 'open innovation' with universities, largely to replace internal research laboratory facilities¹⁵⁷. These partnerships are mutually beneficial as the academic partners are able to contribute research assets, experts, students and IP. Corporate partners can bring new investment dollars to initiatives thereby amplifying the research dollars available to the University. Together, both partners can meet shared research objectives that otherwise may not be able to be accomplished. The University's research excellence has been able to attract multinational corporations to Canada to conduct world-class research.



University of Waterloo's Crash Lab

- IBM selected the University of Waterloo as the only Canadian institution for its IBM Q Network. The IBM Q Network is a community of Fortune 500 companies, startups, academic institutions, and research labs working to advance and explore practical applications for quantum computing.
- The initiative aims to provide its organizations with quantum expertise and resources, quantum software and developer tools, as well as cloud-based access to quantum software and developer tools. The program also offers cloud-based access to IBM's universal quantum computing systems^{158 159}.
- The project for the University of Waterloo will focus on research projects with students and faculty to advance the foundational science, technology, and software required to enable more capable quantum systems. The university will focus on accelerating collaborative research in quantum algorithms and quantum complexity theory¹⁶⁰.

This initiative exemplifies how research partnerships can be viewed as a form of inward investment to Canada that can be attributed to the University's specific characteristics such as the presence of world class research capabilities, its IP policy and institutional ability to support research partnerships.

¹⁵⁷ Urban Land Institute. What Role Can Universities Play in Supporting Economic Competitiveness?

¹⁵⁸ IBM Collaborating with University of Waterloo for Quantum Computing Research. Web source: <https://betakit.com/ibm-collaborating-with-university-of-waterloo-for-quantum-computing-research/>

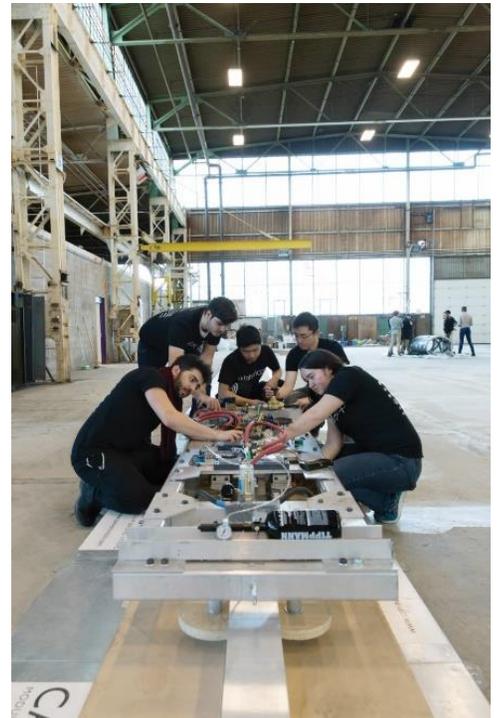
¹⁵⁹ IBM Q Network: An Engine for Discovery. Web Source: <https://www.research.ibm.com/ibm-q/network/overview/>

¹⁶⁰ IBM Q Network: An Engine for Discovery. Web Source: <https://www.research.ibm.com/ibm-q/network/overview/>

5.7. Demonstrating the University’s supports of the adoption of new technologies in Canada

The University does not operate in a silo and instead meaningfully contributes to pan-national research partnerships and initiatives that are specifically directed towards enhancing Canada’s innovation competitiveness. For example:

- **The NRC Collaboration for Artificial Intelligence, Internet of Things, and Cybersecurity:** In 2019 an innovation hub focused on advancing intelligent logistics research was established as a partnership between the University of Waterloo and the National Research Council of Canada (NRC). Internationally recognized researchers from the Faculty of Engineering and the Cheriton School of Computer Science within the Faculty of Mathematics will partner with NRC researchers to advance discoveries in these three key areas. The NRC and University of Waterloo have been collaborating on computer science research and development for over ten years. Examples of research projects currently underway include the development of battery-free Touch Sensors for Internet of Things led by Professor Omid Abari, Cheriton School of Computer Science, and NRC researcher Keiko Katsuragawa¹⁶¹.
- **The Pan-Canadian Expert Collaboration:** Announced in 2019, the Collaboration includes more than 20 post-secondary institutions and research groups from across the country to generate independent research and advice in three areas — carbon pricing, clean energy development, and strategies for climate-change adaptation headquartered at the University of Waterloo.



Student members of Team Waterloo preparing their submission to the Space X Hyperloop pod challenge

5.8. Supporting the adoption of technologies in industry and society



Institute for Quantum Computing researchers working on long distance quantum communication advances

Economic growth is driven by innovation when technologies are successfully diffused across an economy and labour and capital productivity can be enhanced. For Canada, ensuring businesses and families are adopting new technologies has long been identified as a weakness in several reviews of the economy. Several challenges have prevented the adoption of technology by Canadian businesses ranging from difficulty in integrating new advanced technologies with existing systems, standards and processes, a lack of technical support or services (from consultants or vendors) and a lack of employee training on the merits of new technologies¹⁶².

The University helps to support the adoption of technology in several ways. Firstly, in its capacity as a post-secondary institution, the University provides students with in-depth, up-to-date knowledge on the latest technologies and their real life application. As students enter the labour force, they can be better equipped to identify use cases for technologies and integrate them into the business operations and to purchase them individually. This ability directly responds to a key challenge in the Canadian economy:

- In a 2014 review of the barriers to technology adoption in Canada, human resources and talent were identified as significant factors by businesses across sectors and of different sizes with companies.

¹⁶¹ University of Waterloo. 2019. New collaboration hub at Waterloo to advance artificial intelligence, cybersecurity, and Internet of Things. Web source: <https://uwaterloo.ca/research/news/new-collaboration-hub-waterloo-advance-artificial>

¹⁶² Obstacles to the adoption of advanced technologies, by industry and enterprise size. Statistics Canada. 2019

- 30 per cent of companies stating lack of employee training and 38.6 per cent of companies stating employees' resistance to change were the key barriers to companies adopting technologies.

Viewed this way, the University's ability to equip students with a toolkit of skills and training to interact with and understand technologies can help the diffusion of technologies in the economy. In addition, the University has intentionally executed research initiatives that have end objectives of supporting technology adoption.

- For example, Bronwyn Lazowski is part of a national-leading community of sustainable energy leaders at the University of Waterloo. She's also an Energy Council of Canada Energy Policy Research Fellow with the Waterloo Institute for Sustainable Energy (WISE).
- Bronwyn and several other Waterloo alumni support the Reep House which is a living laboratory where Waterloo studies behavioural patterns to help identify barriers to adopting smart energy technology¹⁶³.

The University of Waterloo is also partnering with industry to support technology adoption through the AI for Good Initiative, an investment of \$115 million over five years which provides funding, technology and expertise to individuals, non-profits, academic institutions and organizations to address society's largest challenges by deploying AI¹⁶⁴. Funding has been channeled towards eight new research projects, which aim to develop solutions and enhance adoption of the use of AI to improve emotional discovery in autistic individuals, enhancing climate change projections, developing better fall detection for the elderly, and boosting wildfire management and disaster response¹⁶⁵.

Widespread adoption of AI could yield significant economic impacts as AI is a growing driver of Canada's economy. In 2018, \$548 million in venture capital was invested in Canadian AI companies, an increase of approximately 50% from 2017¹⁶⁶. Sustained demand driven by adoption could also support the additional generation of new jobs related to AI. Canadian job opportunities in the field of AI grew by nearly 500% between June 2015 and June 2017, and this number will only continue to rise¹⁶⁷.

¹⁶³ Smart Home Technology Needs Smart Energy Users. Web Source: <https://uwaterloo.ca/global-impact/smart-home-technology-needs-smart-people>

¹⁶⁴ Microsoft Partners with the University of Waterloo's Artificial Intelligence Institute to Address Society's Greatest Challenges. Web Source: <https://news.microsoft.com/en-ca/2019/06/25/microsoft-partners-with-the-university-of-waterloos-artificial-intelligence-institute-to-address-societys-greatest-challenges/>

¹⁶⁵ Microsoft Partners with University of Waterloo for AI Research. Web source: <https://www.therecord.com/news-story/9451924-microsoft-partners-with-university-of-waterloo-for-ai-research/>

¹⁶⁶ Microsoft Partners with the University of Waterloo's Artificial Intelligence Institute to Address Society's Greatest Challenges. Web Source: <https://news.microsoft.com/en-ca/2019/06/25/microsoft-partners-with-the-university-of-waterloos-artificial-intelligence-institute-to-address-societys-greatest-challenges/>

¹⁶⁷ Microsoft Partners with the University of Waterloo's Artificial Intelligence Institute to Address Society's Greatest Challenges. Web Source: <https://news.microsoft.com/en-ca/2019/06/25/microsoft-partners-with-the-university-of-waterloos-artificial-intelligence-institute-to-address-societys-greatest-challenges/>

6. The University as a Pillar of the Waterloo Region Community

6.1. An introduction to the role of the University in the community

Economic contributions are only one frame of the University of Waterloo's impact. Universities have significant access to financial and human capital and are thereby uniquely positioned to provide certain services to society thanks to the resources they possess. The University of Waterloo, however, can be viewed as an engine of the Region of Waterloo which has directly shaped the character of the community. In consultations with local government and business stakeholders, the University was consistently viewed as a leader and beacon to the community with a reach that extended beyond simply teaching students. The University's contributions to the community can be seen through seven dimensions identified through consultations with local political, economic development, business and innovation leaders. In each case, the University supports the vibrancy and strength of the local community through formal and informal ways summarized in this chapter through the following frames:



- Attracting people around the world to the Waterloo region



- Supporting positive policy outcomes



- Supporting arts and culture



- Championing diversity and inclusion



- Partnering to achieve shared economic development goals



- Building the community through volunteerism

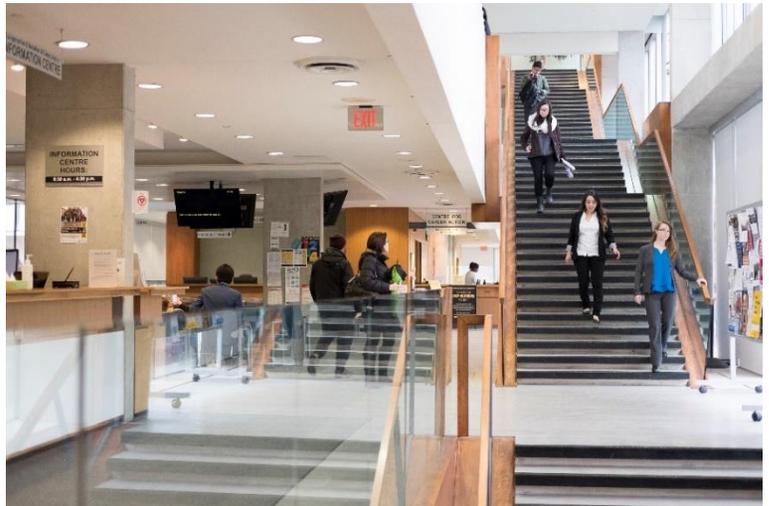


- Educating the next generation

6.2. Attracting people around the world to the Waterloo region

In consultations with local government stakeholders, the most direct mechanism through which the University shapes the community is by attracting and retaining people from around the world with different expertise and worldviews to live in the community. Over time, the University has attracted and retained students and faculty from around the world. Several stakeholders characterized the University as a key driver of the community's welcoming, inclusive community culture that actively celebrates different cultures.

Another dimension to this significant ability is the attraction of a diverse range of professionals to the region. The University often attracts globally leading researchers and faculty to the region who bring with them families with diverse life stories. These families come together and participate in the community – and work for local employers enhancing the fabric of society.

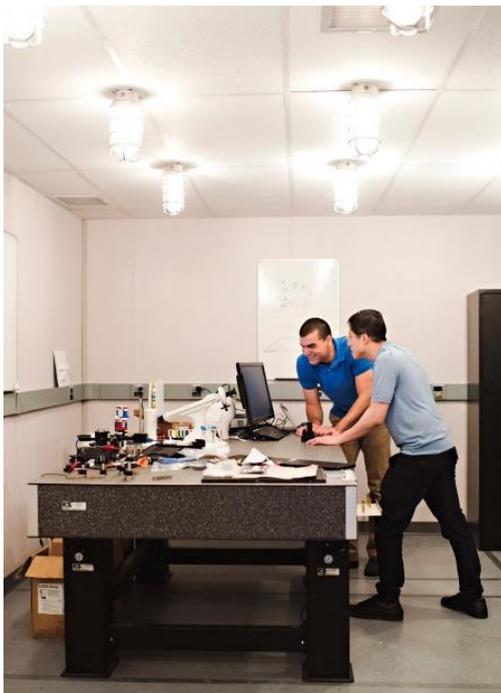


Students at the William M. Tatham Centre for Co-operative Education and Career Action

Case Study: The David Johnston Research + Technology Park

The David Johnston Research + Technology Park is one of the newest research parks in Canada and is uniquely located on the University of Waterloo's North Campus. Designed to accommodate 1.2 million square feet of office space on 120-acres (49 hectares), the Research Park is home to researchers and technology workers and has a significant economic impact on the region. It is also home to evolV1, Canada's first Zero Carbon Building, where the University's Interdisciplinary Centre on Climate Change (IC3) is located.

6.3. Supporting positive policy outcomes



Research lab at the University of Waterloo

In consultations with local government stakeholders, the community was described as a 'can do' community, where people come together to solve problems, and work together to improve the quality of life in their neighbourhoods. An informal, but important mechanism through which the University contributes in this regard is its capacity as a friendly adviser to local governments and the community. In consultations with local government and business leaders, the University was praised for its open door policy and willingness to 'lend' its experts and students to advise on policy issues.

Advising on urban planning decisions: Recently, the municipality of Waterloo was contemplating options related to street lighting. The University offered pro-bono advice on the technological and sustainability profile of both options to enable the municipality to make the most informed decision possible.

Co-creating the next generation of waste energy disposal technology: The Region of Waterloo partnered with an engineering group at the University to combat pollution developing solutions that could leverage energy from idling municipal trucks. This approach could create a 'win-win' for the city as local trucks could create energy that could later cut down on gas requirements for trucks while simultaneously reducing carbon emissions associated with garbage disposal services.

In consultations, stakeholders noted that this type of positive relationship is empowered through the genuine sense of community and civic duty the

University's staff and faculty have viewing their roles as a platform through which to improve and uplift the community.

Enhancing regional sustainability: The University has made policy choices to help combat some of the Waterloo region's key policy challenges. Nearly 50 percent of all greenhouse emissions in the Waterloo region come from transportation¹⁶⁸. To help reduce emissions, the University has set goals to increase the proportion of sustainable commuting trips, and reduce fossil fuel consumption across the campus fleet¹⁶⁹. To meet these goals, the University has invested in new EV charging stations and partnered with the TravelWise program that can help individuals track how much carbon they produce during commute times to help make better choices for the environment.

Supporting a progressive food system: Increasingly, society is concerned about ensuring food is sustainable and minimizes impacts on the environment. In response, the University has prioritized ensuring its food system is sustainable and incorporates locally sourced and fair trade food. During the distribution of food across campus, the University has also made commitments to reduce food related waste by using recyclable packaging and providing incentives to students and staff to use reusable cutlery/mugs etc.

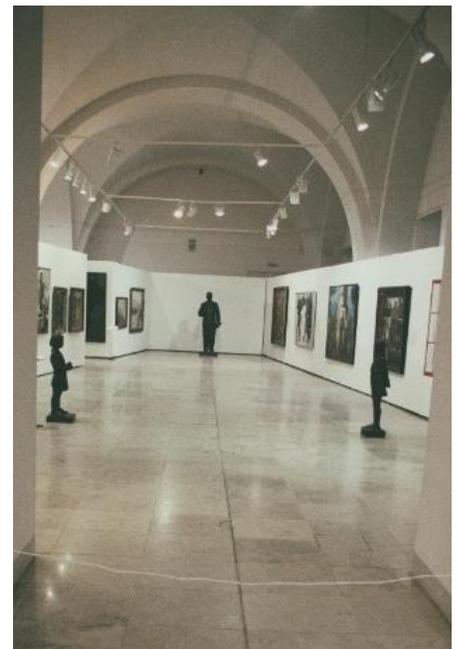
In 2018, St. Jerome's University (federated with the University of Waterloo) was the first university to sign onto the Meal Exchange challenge which is a national campaign that calls on schools to offer ecologically-sound, socially-just, community based, humane food. Students are able to see how their school is performing against these targets using a 'Good Food Calculator'.

6.4. Supporting arts and culture

The University also puts on cultural and social events open to the students and the public that create opportunities for the local community to come together, develop, and strengthen bonds. Key examples include:

- The University of Waterloo Art Gallery hosted 10 exhibitions and co-hosted 16 complementary presentations and related events in 2018.¹⁷⁰
- The University's Earth and Science Museum welcomed over 41,000 visitors in 2018.¹⁷¹
- The University also hosted various sporting events for its athletics teams such as Hockey, Basketball and Football events, selling over 37,000 tickets in 2018.¹⁷²

The impacts on the community are positive, as cultural and arts initiatives are shown to improve educational outcomes and quality of life as well as increase social cohesion¹⁷³. These events also have positive economic impacts on the region by attracting visitors and tourists, and by creating or sustaining jobs associated with these events.



¹⁶⁸ University of Waterloo. 2019. Sustainability and Transportation. Web Source: <https://uwaterloo.ca/sustainability/projects-and-initiatives/transportation>

¹⁶⁹ Ibid

¹⁷⁰ University of Waterloo Statistics. 2019.

¹⁷¹ Ibid.

¹⁷² Ibid.

¹⁷³ Communication MDR. 2016. "Environmental Scan of the Culture Sector. Ontario Culture Strategy Background Document". Web source: https://files.ontario.ca/books/mtcs_environmental_scan_of_the_culture_sector_en_0.pdf

6.5. Championing diversity and inclusion

The vision of a multicultural society in which all citizens keep their identities, take pride in their ancestry and have a sense of belonging is part of Canada's ethos as a nation¹⁷⁴. The University of Waterloo can be viewed as an agent executing against this vision in society. The University's role as a value leader and champion for diversity and inclusion can be seen in several dimensions.



Black and Gold Day

Official commitment to fostering an inclusive environment:

The University has committed to creating an inclusive environment for students and faculty and has a wide range of services and safe spaces to ensure that everyone feels included on campus.

- The University offers the Equitable Recruitment and Selection training to foster equitable representation and promote inclusion by shedding a light on unconscious bias.¹⁷⁵
- The University has committed to boost female participation in STEM experiences to 33%, offering HeForShe IMPACT scholarships to outstanding female students in a STEM program¹⁷⁶. The commitment also includes enhancing female faculty representation and advancing women in positions that lead the University.

Another expression of the University's commitment to diversity and inclusion is how its supportive setting for student-run cultural associations provides a setting through which the University community can raise their awareness for different languages, cuisine and ways of life. The University is home to over 200 social groups that work to raise awareness and celebrate cultures and faiths from around the world¹⁷⁷.

The University's ability to be a positive setting for these types of organizations to thrive has important contributions to the overall quality of experience of the graduates. Research demonstrates that the more administrators and faculty can support student success, the more they can create a sense of belonging, which is an influential factor in whether a student succeeds and develops¹⁷⁸. Examples include:

- The University of Waterloo Indian Cultural Association (UWICA) is a club that aims to promote Indian culture to the staff and students of the University through organizing various cultural events and dance performances.
- Hillel Waterloo is a student run-organization led by a committee of students that act as a resource for Jewish students in Waterloo and share information on Jewish traditions and rituals for the community.
- The Cantonese Multimedia Production is a not-for-profit organization that works with partners to promote the general public's interest in Cantonese language and Hong Kong Culture.

In addition to providing a space for these groups to thrive, the University hosts events where students can enhance their knowledge of different cultures and traditions. For example the Cultural Caravan is an annual celebration hosted by the Federation of Students gathering clubs and cultural groups for dance, talent, and singing performances¹⁷⁹.

Case Study: The Waterloo Indigenous Student Centre

The University also has several partnerships with the community to support cultural awareness. The Waterloo Indigenous Student Centre (WISC) facilitates the sharing of indigenous knowledge and provides culturally relevant information and support services for all members of the University – working in partnership with Kitchener Waterloo

¹⁷⁴ Multiculturalism. Government of Canada. Web Source: <https://www.canada.ca/en/services/culture/canadian-identity-society/multiculturalism.html>

¹⁷⁵ University of Waterloo. 2019. Equitable Recruitment and selection training. Web Source: <https://uwaterloo.ca/human-rights-equity-inclusion/how-can-we-help/education-and-training/equity-workshops-and-resources/equitable-recruitment-and-selection-training>

¹⁷⁶ HeForShe. 2019. "HeForShe Emerging Solutions Report 2018 – University of Waterloo". Web source: <https://heforshe.app.box.com/s/cdm3ddcil5aqfng91rwp9bpooh2mixu7>

¹⁷⁷ University of Waterloo. 2019. Clubs at Waterloo. Web source: <https://uwaterloo.ca/beyond-ideas/stories/student-life/clubs-waterloo>

¹⁷⁸ Cooper, Robin. Constructing Belonging in a Diverse Campus Community. *Journal of College and Character*.

¹⁷⁹ University of Waterloo. 2019. Cultural Caravan. Web Source: <https://uwaterloo.ca/bridge-to-academic-success-in-english/events/cultural-caravan>

Case Study: The Waterloo Indigenous Student Centre cont'd

Region Indigenous organizations. Recently, St. Paul's University College (formally affiliated with the University of Waterloo) became the new academic home for the University of Waterloo's Indigenous Studies Minor program.

The Centre tracks information of topics related to the community as a means to spread awareness of the Indigenous community such as progress against the Truth and Reconciliation Response Projects and Indigenous business and entrepreneurship. Finally, the Centre puts on events such as Pow Wows that are open to all communities. Recently, St. Paul's University College became the new academic home for the University of Waterloo's Indigenous Student Centre

The Waterloo Indigenous Student Centre (WISC) facilitates the sharing of indigenous knowledge and provides culturally relevant information and support services for all members of the University – working in partnership with Kitchener Waterloo Region Indigenous organizations. Recently, St. Paul's University College became the new academic home for the University of Waterloo's Indigenous Studies Minor program.

6.6. Partnering to achieve shared economic development goals

An integral dimension of a community's health is the extent to which it is able to continue to attract investment into its economy. The region has an active economic development ecosystem with partners such as the Greater Kitchener-Waterloo Chamber of Commerce and the Waterloo Economic Development Corporation that work together to continue to grow the local economy. The University is an active partner to these efforts and supports local economic development in several dimensions.

Supporting the region's value proposition for investment:

Several stakeholders stated that the University's strong reputation as a centre for entrepreneurship, and globally competitive research capabilities has become synonymous with the region generally and contributed to a strong regional brand that can help the region compete for investment. For example, a recent investment by a European technology company was attributed in part to the desire to co-locate close to leading edge technology development at the Waterloo Centre for Automotive Research (WatCAR), a center for collaborative research in automotive and transportation systems.

Further, this brand can be seen through several accolades the University has helped the region to secure over the years such as 'Silicon Valley North'¹⁸⁰, Canada's Brain Belt¹⁸¹, finalist in the Smart Cities Challenge (large municipality category) – a competition based approach that encourages communities to come up with innovative solutions to their most pressing challenges¹⁸².



The University of Waterloo's Velocity, Canada's most productive incubator

- In addition to the credibility the University lends to the region's economic development profile, in consultations with the Waterloo EDC, the University was framed as an 'enthusiastic' partner in economic development activities having participated in over 56 international delegations with 292 delegates and several economic development conferences, pitches and meetings. The University is often included in site selection tours of the region, in particular – economic development organizations often profile the University's specialized research capabilities as a means to attract pioneering companies to the region. Moreover, the presence of the University's globally esteemed staff and supply of students often create compelling business cases for investors.
- Importantly, the University's ability to support economic development extends beyond its own backyard and is of national significance. For example, the University was featured prominently in the Toronto region's submission to compete for Amazon's second North American headquarters (Amazon HQ2). The Toronto Region was the only submission from Canada to be shortlisted for consideration.

¹⁸⁰ Fraser, L. 2016. Silicon Valley North? Toronto, Waterloo position themselves as next tech hub. CBC. Web Source: <https://www.cbc.ca/news/canada/kitchener-waterloo/silicon-valley-toronto-waterloo-1.3519032>

¹⁸¹ Bratishenko, L. 2016. This is the new 'brain belt'. Macleans. Web Source: <https://www.macleans.ca/culture/books/this-is-the-new-brain-belt/>

¹⁸² Smart Waterloo Region. Web Source: <https://www.regionofwaterloo.ca/en/doing-business/smart-waterloo-region.aspx>

Champion regional economic development: Importantly, the University is not focused on economic development in its own backyard only. In recent years, government and economic development stakeholders have also championed the concept of the Toronto-Waterloo Innovation Corridor which captures the vitality and concentration of economic activity in Southern Ontario communities which can be seen as an integrated regional economy that is viewed as 112 kilometers of innovation - and a global centre of talent, growth, innovation and discovery – and the second largest technology cluster in North America. University of Waterloo graduate live and work across the region and several companies have an important presence across the region, extending the University’s footprint across the province.

Case Study: Mike Lazaradis

In 1979, Mike Lazaradis enrolled at the University of Waterloo where he pursued studies in electrical engineering. Along with two close friends, Mike later launched Research in Motion (RIM), a computer science and electronics consulting business that gained worldwide recognition for introducing the BlackBerry mobile device in 1999. Following this success, Mike has taken several steps to give back to the University of Waterloo and the community. After RIM achieved global success, Mike and his family chose to invest over \$122 million to the University of Waterloo in various initiatives. Among his notable contributions to the University community, Mike provided funding to help establish the Institute for Quantum Computing (IQC) and the Perimeter Institute for Theoretical Physics – key research assets in Canada. Mike has said that he views his [contributions to the region] as “philanthropy re-imagined: philanthropy as a long-range strategic investment”¹⁸³

Mike is helping the next generation of entrepreneurs and innovators through Quantum Valley Investments which funds and promotes breakthrough technologies and help develop the “Quantum Valley” identity in the Waterloo Region.

Mike also gives back to the community by providing his leadership and expertise to the University in other ways. He has volunteered and sat on various committees for the University of Waterloo as a member of the Board of Governors and through his role as the Chancellor of Emeritus. Ultimately, Mike’s extensive contributions towards the University and the Waterloo region have elevated the University’s brand and provided an abundance of resources for future students to access.

¹⁸³ Quantum Valley Ideas Lab. May 2019. Web source: <http://www.quarterly.exchange/2019/May/feature1/>

6.7. Building the community through volunteerism



United Way Train Pull

can bring the full breadth of its resources and community together to support community causes. Since 1983, students, faculty and staff at the University of Waterloo have raised \$2.46 million for the United Way Kitchener Waterloo and Area. Funds support local not-for-profit community organizations and “make the community a better place”¹⁸⁶.

- The University’s partnership with the United Way is run by 100 volunteers who are committed all year long to executing fundraising events and raising awareness of the partnership.

The social and economic benefits brought to a community through volunteering activities are numerous and significant. For volunteers, it can improve their life satisfaction and health, and have a positive impact on their work life, as they are able to acquire new skills and knowledge¹⁸⁷ while helping organizations. As volunteering activities are stemming from human relationships, the Waterloo community benefits from the activities by seeing an increase in social cohesion, relationship building, solidarity and support.

6.8. Educating the next generation

The University does not only enrich the career prospects and skills base of its students, but supports the next generation of youth talent in Canada through its youth initiatives.

- The University offers access to camp designed to be educational and enjoyable, such as the Music Camp or the Quantum Cryptography School for Young Students¹⁸⁸.
- The University Engineering Faculty hosts Go ENG girl, welcoming girls from grade 7 to 10 to visit the University, learn about engineering and meet women studying in the field¹⁸⁹.
- In addition, the University supports local partners through The University events for the youth such as Math Circles, the Waterloo Public Library’s Literacy Day and summer programming at the Kitchener public library.
- The University also sponsors Engineering Science Quest - a Science and Engineering camp sponsored by Actua which



Quantum Nano Centre and Peter Russel Rock Garden

184 University of Waterloo. 2019. Health & well-being: Community partnerships. Web source: <https://uwaterloo.ca/community-relations/community-impact/health-and-well-being/community-partnerships>

185 University of Waterloo. 2014. Take Back the Night. Web source: <https://uwaterloo.ca/events/events/take-back-night>

186 University of Waterloo. 2019. Community Impact Report. Web Source: <https://uwaterloo.ca/community-impact-report/2015/feature/part-of-your-community>

187 Conference Board of Canada. 2018. “Value of volunteering in Canada”. Web Source:

https://volunteer.ca/vdemo/Campaigns_DOCS/Value%20of%20Volunteering%20in%20Canada%20Conf%20Board%20Final%20Report%20EN.pdf

188 University of Waterloo. 2019. Youth programs and camps. Web source: <https://uwaterloo.ca/youth-programs-and-camps/>

189 University of Waterloo. 2019. Go ENG Girl.

offers multiple summer camps for children entering grades 1 to 9. Annually, the summer camp fills close to 3,000 spots and runs in various rural and indigenous locations in Ontario¹⁹⁰.

- In addition to supporting skills development, the University has also executed initiatives designed to support overall wellbeing. For example, Conrad Grebel University College students have delivered peace-building workshops for over 2,400 local youth to help reduce conflict and bullying¹⁹¹.

By providing these initiatives to youth, the University is participating in their development and helping them increase their social and academic skills. For youth, participating in such initiatives can contribute to better academic outcomes¹⁹², and help to develop problem solving capacities¹⁹³. Additionally, by offering access to artistic activities, the University helps the community by supporting teens that will be more involved in their community, volunteerism and politics as adults^{194,195,196}.

Case Study: The University's contributions to the community of Stratford

While the University resides in the City of Waterloo, its footprint extends across the Greater Waterloo region. Established in 2009, the University invested in its first ever presence in the City of Stratford- the University of Waterloo Stratford School of Interaction Design and Business. The campus offers undergraduate and graduate programs in digital arts and design within a global business framework. In consultations with Stratford government officials, the relatively small campus was noted to be contributing significantly to the community's socio-economic fabric including:

Uplifting the real estate market: The campus, located in downtown Stratford was attributed to elevating the standard for professional space in the City, and anecdotally to an uplift in surrounding industrial real estate values in and around the campus.

Partnering to address shared community causes: The Stratford campus of the University is an active civic participant in the region. For example, in March 2019 – the University and Stratford Public Library hosted a Community Dialogue focused on living with less plastic. The event was hosted on the University's campus and was intended to educate residents on the impacts of plastic on the local water system and what residents can do personally to reduce the amount of plastic they use.

The University has also launched the Community Health Environment Communications Initiative which has conducted sessions with community leaders to address challenges in the community that could be addressed through research. The Initiative is in its early stages but can be expected to be a valuable channel through which the University supports the community¹⁹⁷.

Attraction of students and staff to the region: In consultations, the campus was attributed to attracting students and university employees to live and work in Stratford. Broadly, stakeholders emphasized that students and faculty contribute economically to the region by spending at local businesses. For local employers, the campus has also provided a funnel of part-time employees that can support the City's key industries.



University of Waterloo Stratford School of Interaction Design and Business

190 University of Waterloo. 2019. Engineering Science Quest. Web Source: <https://uwaterloo.ca/engineering-science-quest/about>

191 Community Impact Report. Web source: <https://uwaterloo.ca/community-impact-report/2015/feature/connecting-students-their-community>

192 Heath, S. B., Soep, E., & Roach A. (1998). Living the arts through language-learning: A report on community-based youth organizations. *American for the Arts Monographs*, 2(7), 1-20

193 Rostan, S. M. (2010). Studio learning: Motivation, competence, and the development of young art students' talent and creativity. *Creativity Research Journal*, 22, 261-271

194 Stevenson, L., Limón, C. J., & Reclusado, T. (2013). Community-based afterschool and summer arts education programs: Positive impact on youth and community development. *Expanding and Opportunities*, 79-82.

195 Heath, S. B., Soep, E., & Roach A. (1998). Living the arts through language-learning: A report on community-based youth organizations. *American for the Arts Monographs*, 2(7), 1-20

196 Catterall, J. S., Chapleau, R., & Iwanaga, J. (1999). Involvement in the arts and human development. In E. B. Fiske (Ed.), *Champions of change: The impact of the arts on learning* (pp. 1-18). Washington, DC: Arts Education Partnership

197 Stratford Campus is Building Connections in Our Community. Web Source: <https://uwaterloo.ca/community-relations/blog/post/stratford-campus-building-connections-our-community>

Taken together, the University's presence in the region can be viewed as much more than a place of higher learning and a major employer. The University has actively and consciously focused on becoming a partner and asset to the community and is an integral part of the overall quality of life of the region.

7. Conclusion

Our review indicates that the University of Waterloo contributions to the economy are notable and extend well beyond the classical ways Universities impact the economy. Through its Co-op program, the University is able to support quantifiable gains for employers while setting students up to command wage premiums and succeed in their careers. The University has also invested in a successful ecosystem of entrepreneurship that has spun off companies with significant economic impacts across a range of industries. As the University invests in its research capacity, it indirectly supports Canadian innovation competitiveness – a key dimension to economic prosperity. Finally, the University’s commitment to being an active partner within its community deeply embeds it within the fabric of the Waterloo region. In the coming years, we can expect the University to continue to drive these impacts. Taken together, the University of Waterloo can be seen as a national asset, and important contributor to the Waterloo region, Ontario and Canadian economies.

Appendix A: Stakeholders Consulted

- Barnett, K. (2019, June 17). Phone Interview.
- Tunncliffe, E. (2019, June 12). Phone Interview
- Duncan, K. (2019, May 21). Phone Interview.
- Duarte, N. (2019, May 16). Phone Interview.
- McLennan, L. (2019, May 24). Phone Interview.
- Schnarr, J. (2019, May 21). Phone Interview.
- Chan, S. (2019, May 2019). Phone Interview.
- Mitra, S. (2019, May 15). Phone Interview.
- Randall, N. (2019, May 16). Phone Interview.
- Nathwani, J. (2019, May 16). Phone Interview.
- Kerschbaum, F. (2019, May 23). Phone Interview.
- Burns, C. (2019, May 17). Phone Interview.
- Scott, D. (2019, May 15). Phone Interview.
- Resch, K. (2019, May 16). Phone Interview.
- Jaworsky, D. (2019, May 22). Personal Interview.
- Klugman, I. (2019, May 22). Personal Interview.
- McLean, I. (2019, May 22). Personal Interview.
- La Mantia, T. (2019, April, 24). Personal Interview
- Horne, R. (2019, April, 27). Phone Interview
- Basiri, M. (2019, April 5). Phone Interview
- Rendall, M. (2019, June 27). Phone Interview
- Allen, E. (2019, July 02). Phone Interview.
- Rehman, A. (2019, July 10). Phone Interview.
- Wong, A. (2019, June 06). Phone Interview.

Appendix B: Economic Contribution Model and Assumptions

B.1 Economic contribution definitions

Direct Contribution: Direct economic contribution represents the economic value added directly associated with capital investments and associated operations. For example, they include the employment and income of faculty and staff directly involved with the University, as well as the associated product, production taxes and property taxes paid.

Indirect Contribution: Indirect economic contribution represents the economic value added resulting from the demand for materials and services that the University generates in supplier industries. They represent, for example, economic activity generated in the manufacturing, wholesale trade, transportation and professional service sector as a result of demand for materials and services generated by the University of Waterloo.

Induced Contribution: Induced contribution represents general income effects associated with the expenditure of wages earned as a result of the direct and indirect contribution. Example of this contribution are purchases of goods and services at the household level.

Gross Domestic Product (GDP): GDP is the total unduplicated value of goods and services produced in the economic territory of a country or region during a given period. GDP includes household income from current productive activities (wages, salaries and unincorporated business income) as well as profits and other income earned by corporations. In the context of our study, GDP serves as a measure of the total economic value-added resulting from the spending associated with the categories of expenditure identified.

Employment: In this study employment contribution is estimated in terms of full-year equivalent positions for ongoing employment (i.e. employment contribution associated with annual expenditures). Full-year equivalent positions are counted according to their duration and not according to whether they were employed on a full-time or part-time basis. That is, two part-time employees would be counted as one full-year equivalent if the total time they spent on the job adds up to one year. This approach is consistent with standard statistical terminology.

Labour Income: Labour income represents the total earnings of employees (including employees of suppliers to the projects), consisting of wages and salaries as well as supplementary labour income (such as employer's contribution to pension funds, employee welfare funds, the Unemployment Insurance Fund and Workers Compensation Fund).

Government Revenues: In this study, government revenue includes federal, provincial, and municipal products and production taxes such as sales tax (GST), payroll taxes, property tax, and excise duty. This report also includes corporate income taxes and personal income taxes.

Region of Waterloo (or 'Waterloo Region'): The local area or Waterloo region is defined to encompass Kitchener-Cambridge-Waterloo Census Metropolitan Area, Toronto Census Metropolitan Area, London Census Metropolitan Area, and Hamilton Census Metropolitan Area.

B.2 Economic contribution model and assumptions

Introduction to Input-Output Modelling

Input-Output models (I-O models) are used to simulate the economic contribution of an expenditure on a given basket of goods and services or the output of one of several industries. Input-Output analysis uses data on the flow of goods and services among various sectors of the economy, and attempts to model how an expenditure, increase in demand, or investment ripples through a region's economy. This is done by mapping the production of products and service by each industries, and identifying the intermediate inputs used in the production of each final product or service used by consumers, sold as an export, or purchased by government. The model can then aggregate all of the employment and value added contributions generated in the supply chain as commodities are produced. I-O models also consider the role of imports, which tie the supply chain to the global economy. This data is combined into a single model of the economy which can be solved to determine how much additional production is generated by a change in the demand for one or more commodities or by a change in the output of an industry.

Deloitte used the Statistics Canada Interprovincial Input-Output model to generate the results in this report.

Assumptions and Limitations of the Model

The Statistics Canada Interprovincial Input-Output model is subject to a number of general assumptions and limitations. The model reflects a simplified macroeconomic structure, and does not include some variables of interest for macroeconomic analysis such as interest rates, unemployment rates, or income tax rates. The model assumes that the Canadian economy has the capacity to produce the goods and services stimulated by the economic shock. The model is not able to forecast situations in which demand may outpace the capacity to produce the required goods and services, however it does estimate the portion of goods and services sourced from other provinces in Canada and internationally. The model makes a basic underlying assumption that the number of jobs created maintains a linear relationship with short-term gross output. "This approach can be considered sound if the value and quantity measures are for the same year and the analysis is focusing on the structure of the economy for that same year. When used for projecting beyond the IO model year, the relationship between values and quantities may be [impacted] by price variations." For more information on the assumptions and limitations of the model, please refer to "*The guide to using the input-output simulation model*", which is available free of charge upon request from Statistics Canada.

Appendix C: Methodology Details and Supplementary Information

C.1 Methodology details for local impacts

Provided below is an overview of the methodology used to calculate local impacts at the direct, indirect, and induced levels:

- Estimates for direct economic contribution is derived by applying the respective share of expenditures in the Waterloo region relative to Ontario on the associated Ontario level impacts.
 - The Waterloo region expenditure data by location was provided by the University for capital and operating expenditures. The data provided indicates that nearly the entire capital and operating expenditures occur in Waterloo region. It can be noted that operating estimates for labour income, and jobs are based on actual staffing, and salaries and benefits in the Waterloo region provided by the University.
 - Given the local nature of expenditures, it was assumed that 100% of out-of-town student expenditures occur in Waterloo region.
 - To attribute the share of co-op employment located in Waterloo region, our analysis uses employment data obtained from Statistics Canada. According to Statistics Canada, Waterloo region comprises 58% of Ontario's All Industry employment.¹⁹⁸
 - According to results from the University's 2015 Alumni Entrepreneurial Survey, over half of all Ontario-based spin-offs are located within Waterloo region.
- Estimates for indirect and induced economic contribution are based on employment shares, used to determine the share industries in the Waterloo region compared to the economy of Ontario as a whole. The share of industry concentration in the Waterloo region is applied on the Ontario level impacts to determine the share attributable to the Waterloo region. The calculation of employment shares utilizes regional employment data from the Statistics Canada 2016 Census of Population.

C.2 Geographic distribution of operational and capital expenditures

Based on data provided by the University, annual operating expenditures totaled **\$853M** in 2017-18 FY. This figure includes spending on staff salaries and wages, materials and equipment, professional services, administrative support and others.¹⁹⁹

¹⁹⁸ Obtained from Statistics Canada, 2016 Census of Population.

¹⁹⁹ Excluded from the analysis is \$121M allocated towards scholarships and bursaries to avoid risks of double counting with student expenditure analysis.

A breakdown of these expenditures by type and region is provided in the table below.

Table 8: Distribution of the University of Waterloo's Annual Operations Expenditures (2017-18 FY)

Expenditure Type	Waterloo Region	Ontario	Canada
Salaries and Benefits	\$618.1M	\$618.1M	\$618.1M
Professional and business services	\$4.8M	\$8.0M	\$11.1M
General administration	\$27.2M	\$27.8M	\$27.8M
Office supplies	\$24.6M	\$24.6M	\$24.6M
Transportation and storage	\$5.6M	\$6.4M	\$7.2M
Office furniture and material purchase	\$9.8M	\$9.8M	\$9.8M
Equipment	\$18.8M	\$21.5M	\$22.8M
Computer hardware purchases	\$15.3M	\$15.3M	\$15.3M
Utilities	\$19.4M	\$19.4M	\$19.4M
Other Expenditures	\$93.8M	\$93.8M	\$93.8M
Municipal taxes	\$2.9M	\$2.9M	\$2.9M
Total	\$840.3M	\$847.6M	\$852.9M

The University's expenditures on capital investments totaled **\$53M** in 2017-18 FY. This includes spending on building repairs/renovations, materials and equipment and other expenses²⁰⁰.

A breakdown of these expenditures by type and region is provided in the table below.

Table 9: Distribution of the University of Waterloo's Capital Expenditures

Expenditure Type	Waterloo Region	Ontario	Canada
Building repairs/renovations	\$47.8M	\$47.8M	\$47.8M
Office furniture and material purchase	\$1.6M	\$1.6M	\$1.6M
Equipment	\$2.4M	\$2.7M	\$2.9M
Computer hardware purchases	\$1.1M	\$1.1M	\$1.1M
Total	\$52.9M	\$53.2M	\$53.4M

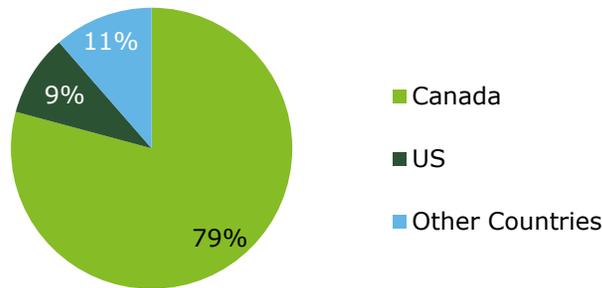
C.3 Geographic distribution of companies that have spun out of the University of Waterloo

Survey results indicate that the majority of spin-off companies are headquartered within Canada (79%), while the remaining are based in the US (9%), and other countries (11%). Of the companies located within Canada, the majority are based in Ontario, with over half located in Waterloo region.²⁰¹

²⁰⁰ Expenditures incurred outside Canada were not included in estimating the economic contribution of the University.

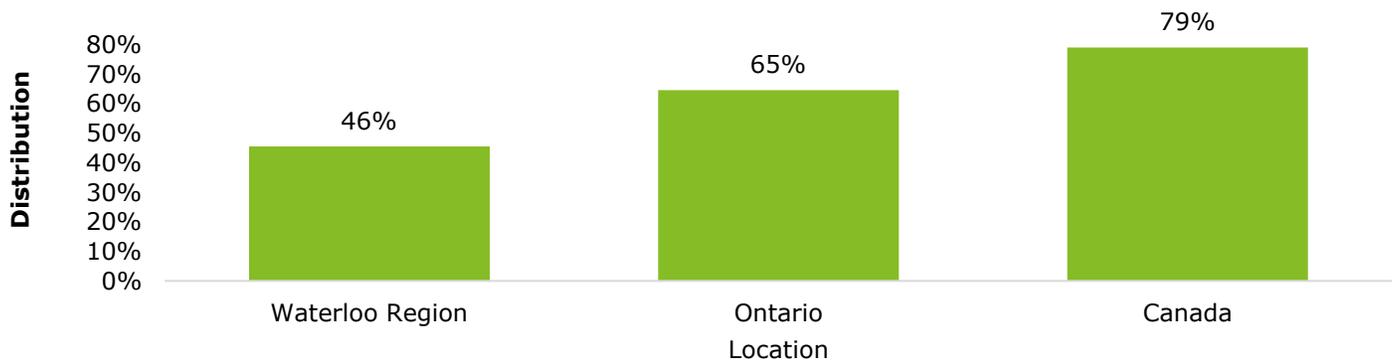
²⁰¹ University of Waterloo (2016). Understanding Entrepreneurship among the University of Waterloo's Alumni.

Figure 18: Geographic Distribution of the University’s Spin-off Businesses



Source: University of Waterloo (2016). Understanding Entrepreneurship among the University of Waterloo’s alumni.

Figure 19: Breakdown of Location of Spin-off Businesses in Canada



Source: University of Waterloo (2016). Understanding Entrepreneurship among the University of Waterloo’s Alumni

C.4 Detailed overview of methodology to estimate research expenditures impact

Provided below is an overview of the methodology used to calculate the economic impact in 2018/2019 of the University’s research expenditures incurred between 2014/2015 and 2018/2019.

While the University’s data and financial information are presented by fiscal year, the data extracted from Statistics Canada was only available by calendar year. To estimate the impact of the University’s research activities by fiscal year and insure consistency throughout the report, our analysis assumes there is no difference between fiscal and calendar year for the reference period.

1. Estimates for the GDP growth in Ontario is derived by applying Martin’s approach on data obtained from Statistics Canada.²⁰²
 - Due to a lack of more recent data, the GDP growth rate was estimated between 2014 and 2018. Using the Ontario yearly gross domestic product for the time period, we applied the formula below, used by Martin, to estimate the GDP growth. We’ve estimated an average growth rate of 2.5%. Our analysis assumes the rate applied from 2015 to 2019.

$$GDP_{t+1} = (1 + r)^n \times GDP_t$$

- Given the GDP data obtained from Statistics Canada was in 2012 chained dollars, we’ve adjusted the results to 2019 using the inflation calculator from Bank of Canada. After adjusting for inflation, we estimated the Ontario GDP growth between 2015 and 2019 to be equal to \$120,167 million.

²⁰² Statistics Canada. 2019. Table 36-10-0402-02 Gross domestic product (GDP) at basic prices, by industry, provinces and territories, growth rates (x 1,000,000). Web Source: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040202>

2. Estimates for the share of Ontario GDP growth attributable to multifactor productivity (MFP) is derived by applying Statistics Canada methodology on data obtained from Statistics Canada.²⁰³
 - Due to a lack of more recent data, the MFP was estimated between 2013 and 2017, using a compounded average growth rate, per Statistics Canada. Our analysis assumes the rate applied for the year 2018.
 - Multifactor productivity accounted for an estimated 23% of the national GDP change between 2013 and 2017. Due to a lack of data at the provincial level our analysis assumed the same MFP applied to the GDP growth in Ontario.
3. Estimates for the domestic share of MFP is taken from Martin's paper. It is used to exclude impact from research and development activities done by foreign countries.
 - Martin computed the share attributable to foreign countries by using existing literature on the subject. In his paper, he averaged the foreign contribution to TFP found in two sources and adding a minimum suggested by another paper. The OECD (1996) suggested that 42% of the Canadian TFP came from outside of Canada, while Bayourmi and al. (1996) suggested 21%. Additionally, Mohnen (1994) estimated the share between 25% and 65%. Martin also added 2% to take into account foreign trade, following the paper by Bayourmi and al.
 - Martin estimated the share of MFP originating from foreign countries to 31%.
4. Estimates for the share of Ontario research and development performed by the higher education sector (HES) is derived using data from Statistics Canada.²⁰⁴
 - Due to a lack of more recent data, the share performed by the higher education sector was estimated between 2012 and 2016 using a weighted average. Our analysis assumes the rate applied for the year 2018.
 - We estimated the higher education sector performed 36% of expenditures on research and development in Ontario between 2012 and 2016.
5. Estimates for Waterloo share of Ontario R&D performed by the higher education sector were derived using data from the Canadian Association of University Business Officers' Financial Information of Universities and Colleges.
 - The University of Waterloo expenditures on sponsored research answered for 7% of Ontario universities expenditures on sponsored research. The University spent over \$192 million during the FY 2017/2018.

²⁰³ Statistics Canada. 2019. Table 36-10-0208-01 Multifactor productivity, value-added, capital input and labour input in the aggregate business sector and major sub-sectors, by industry. Web Source: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610020801>

²⁰⁴ Statistics Canada. 2019. Table 27-10-0273-02 Expenditures on research and development (R&D) by performing sector (x 1,000,000). Web Source: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2710027302>

Figure 20: Summary of Distribution of Economic Impact of University of Waterloo Research Expenditures

Research Impact	
Ontario GDP Growth (2015-2019) ¹	\$120,167M
Multifactor productivity (MFP) (x 23%) ²	\$27,653M
Domestic share of TFP (x 69%) ³	\$19,081M
Share of Domestic Research by Ontario Universities (x 36%) ⁴	\$6,928M
Share of Domestic Research by University of Waterloo (x 7%) ⁵	\$458M

¹ Deloitte Analysis & Statistics Canada, Table 36-10-0402-02

² Deloitte Analysis & Statistics Canada, Table 36-10-0208-01

³ Martin, Fernand. 1998. The economic impact of Canadian university R&D

⁴ Deloitte Analysis & Statistics Canada Table 27-10-0273-02

⁵ CAUBO 2017/2018. Financial Information of Universities and Colleges

Appendix D: Breakdown of Direct, Indirect and Induced Economic Contributions

D.1 Breakdown of economic contribution from University operations

National level

Accounting for direct, indirect, and induced economic contributions, the University’s 2017/18 FY operating expenditures contributed an estimated **\$1,527M** to Canada's GDP, of which **\$1,003M** is contribution to labour income. It is also estimated that **12,168 FTEs** were created or sustained across Canada.

In addition, it is estimated that the University’s operating expenditures generated **\$197M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 21: Operating Expenditure Contribution to GDP, Labour Income and Employment in Canada (\$Millions and FTEs)

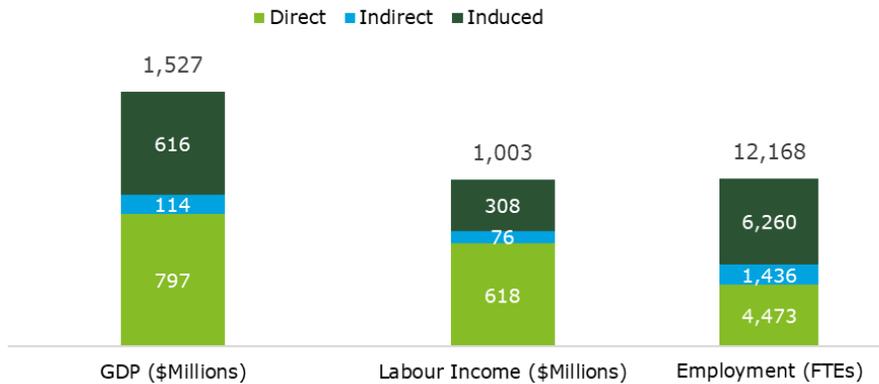
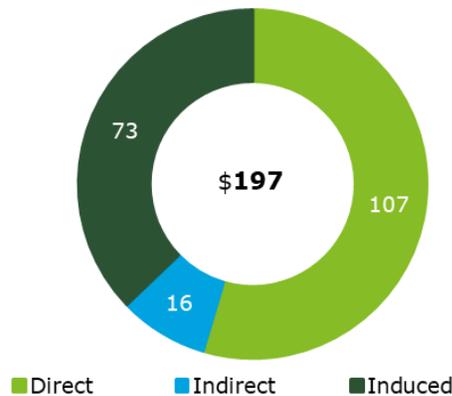


Figure 22: Operating Expenditure Contribution to Government Revenues in Canada (\$Millions)



Provincial level

Accounting for direct, indirect, and induced economic contributions, the University’s 2017/18 FY operating expenditures contributed an estimated **\$1,400M** to Ontario’s GDP, of which **\$949M** is contribution to labour income. It is also estimated that **11,017 FTEs** were created or sustained in Ontario.

In addition, it is estimated that the University’s operating expenditures generated **\$168M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government

Figure 23: Operating Expenditure Contribution to GDP, Labour Income and Employment in Ontario (\$Millions and FTEs)

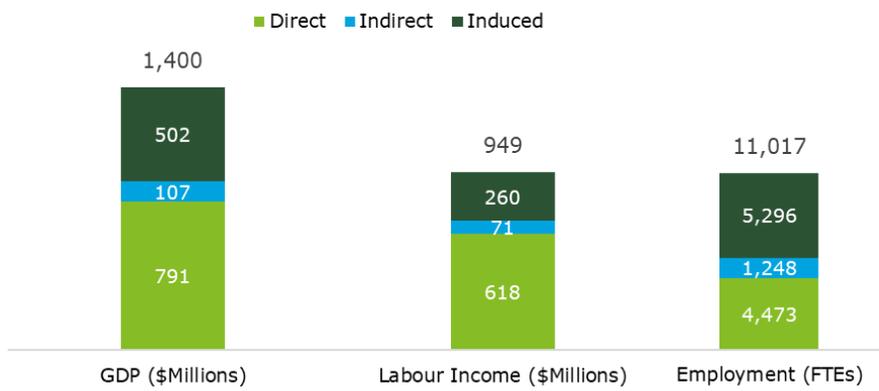
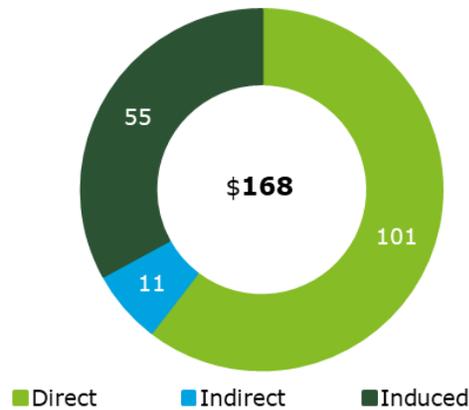


Figure 24: Operating Expenditure Contribution to Government Revenues in Ontario (\$Millions)



Local level

Accounting for direct, indirect, and induced economic contributions, the University’s 2017/18 FY operating expenditures contributed an estimated **\$1,158M** to the Waterloo region's GDP, of which **\$821M** is contribution to labour income. It is also estimated that **8,485 FTEs** were created or sustained in the Waterloo region.

In addition, it is estimated that the University’s operating expenditures generated **\$14M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the municipal government.

Figure 25: Operating Expenditure Contribution to GDP, Labour Income and Employment in the Waterloo region (\$Millions and FTEs)

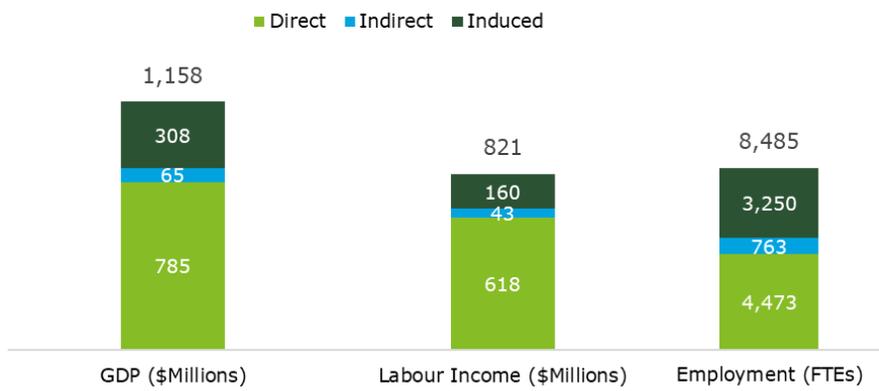
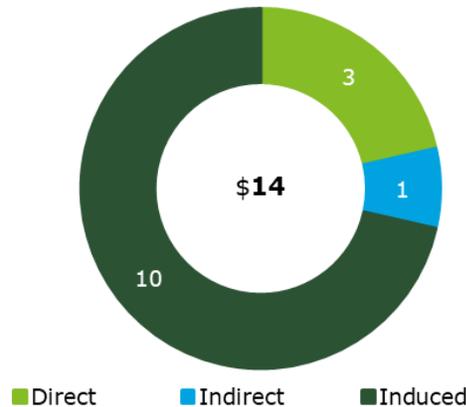


Figure 26: Operating Expenditure Contribution to Municipal Government Revenues in the Waterloo region (\$Millions)



D.2 Breakdown of economic contribution from University capital expenditures

National level

Accounting for direct, indirect, and induced economic contributions, the University's 2017/18 FY capital expenditures contributed an estimated **\$60M** to Canada's GDP, of which **\$39M** is contribution to labour income. It is also estimated that **1,090 FTEs** were created or sustained across Canada.

In addition, it is estimated that the University's capital expenditures generated **\$14M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 27: Capital Expenditure Contribution to GDP, Labour Income and Employment in Canada (\$Millions and FTEs)

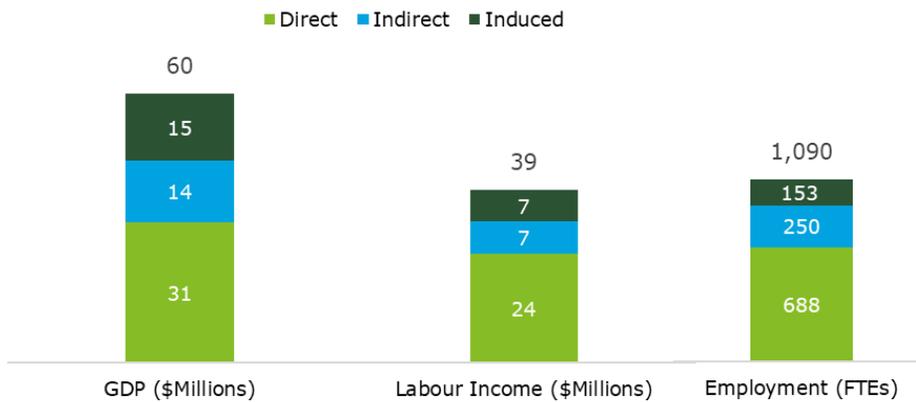
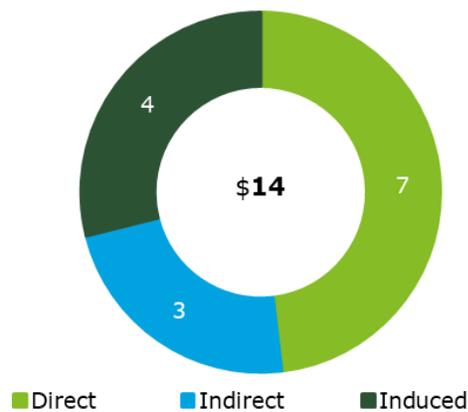


Figure 28: Capital Expenditure Contribution to Government Revenues in Canada (\$Millions)



Provincial level

Accounting for direct, indirect, and induced economic contributions, the University’s 2017/18 FY capital expenditures contributed an estimated **\$54M** to Ontario’s GDP, of which **\$36M** is contribution to labour income. It is also estimated that **1,064 FTEs** were created or sustained in Ontario.

In addition, it is estimated that the University’s capital expenditures generated **\$11M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 29: Capital Expenditure Contribution to GDP, Labour Income and Employment in Ontario (\$Millions and FTEs)

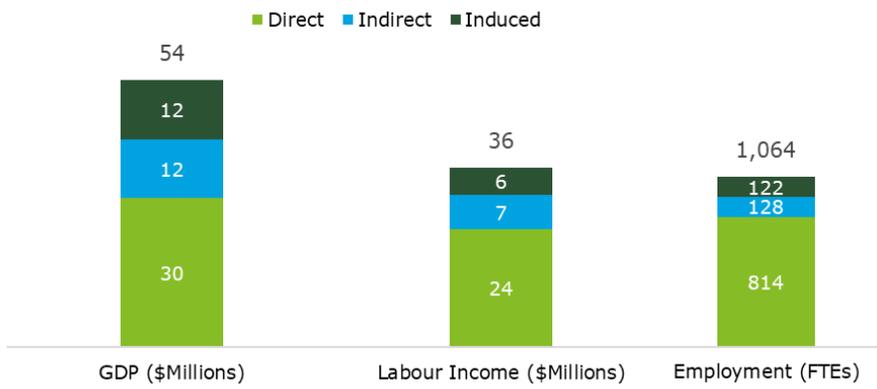
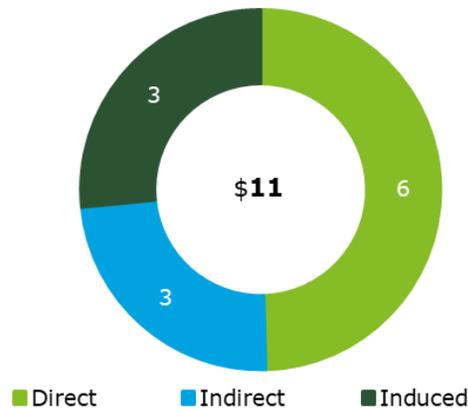


Figure 30: Capital Expenditure Contribution to Government Revenues in Ontario (\$Millions)



Local level

Accounting for direct, indirect, and induced economic contributions, the University’s 2017/18 FY capital expenditures contributed an estimated **\$44M** to the Waterloo region's GDP, of which **\$31M** is contribution to labour income. It is also estimated that **961 FTEs** were created or sustained in the Waterloo region.

In addition, it is estimated that the University’s capital expenditures generated **\$1M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the municipal government.

Figure 31: Capital Expenditure Contribution to GDP, Labour Income and Employment in the Waterloo region (\$Millions and FTEs)

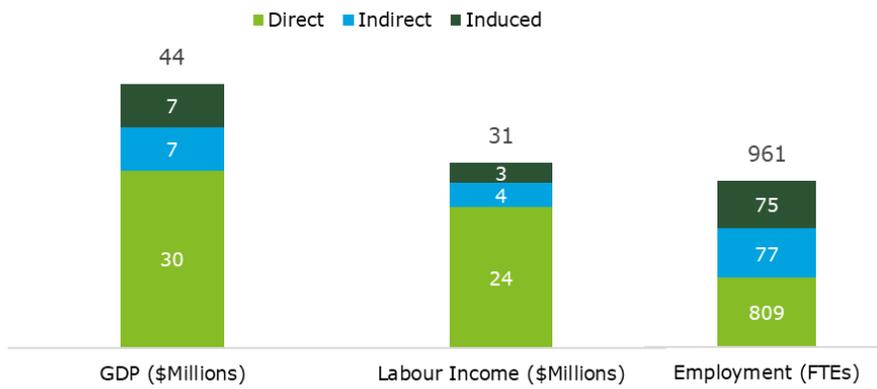
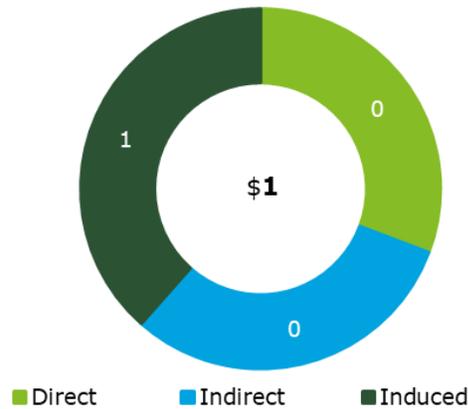


Figure 32: Capital Expenditure Contribution to Municipal Government Revenues in the Waterloo region (\$Millions)



D.3 Breakdown of economic contribution from out-of-town student expenditures

National level

Accounting for direct, indirect, and induced economic contributions, out-of-town student expenditures contributed an estimated **\$412M** to Canada's GDP, of which **\$212M** is contribution to labour income. It is also estimated that **4,831 FTEs** were created or sustained across Canada.

In addition, it is estimated that out-of-town student expenditures generated **\$97M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 33: Out-of-Town Student Contribution to GDP, Labour Income and Employment in Canada (\$Millions and FTEs)

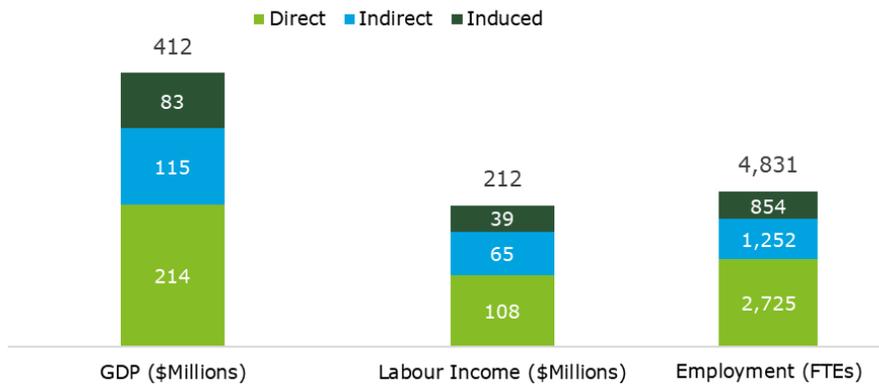
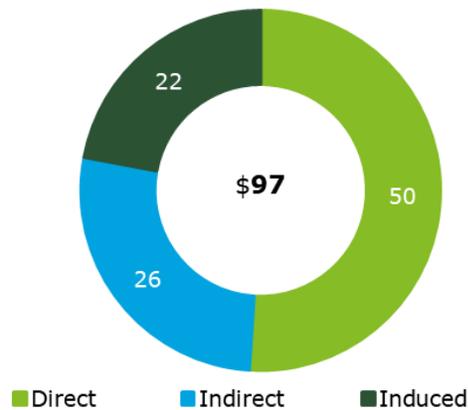


Figure 34: Out-of-Town Student Contribution to Government Revenues in Canada (\$Millions)



Provincial level

Accounting for direct, indirect, and induced economic contributions, out-of-town student expenditures contributed an estimated **\$358M** to Ontario's GDP, of which **\$179M** is contribution to labour income. It is also estimated that **4,210 FTEs** were created or sustained in Ontario.

In addition, it is estimated that the out-of-town student expenditures generated **\$75M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 35: Out-of-Town Student Contribution to GDP, Labour Income and Employment in Ontario (\$Millions and FTEs)

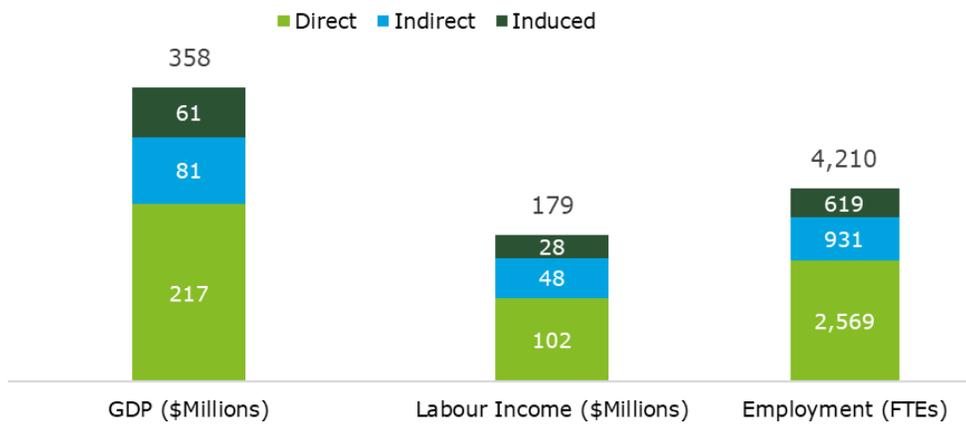
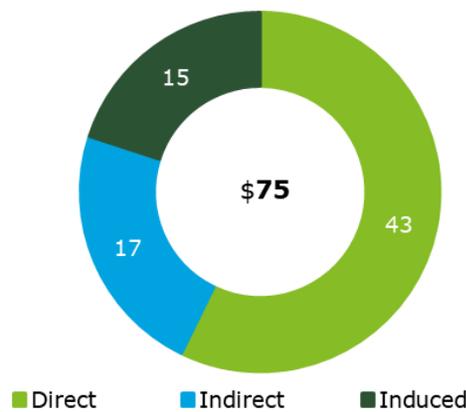


Figure 36: Out-of-Town Student Contribution to Government Revenues in Ontario (\$Millions)



Local level

Accounting for direct, indirect, and induced economic contributions, out-of-town student expenditures contributed an estimated **\$303M** to the Waterloo region's GDP, of which **\$149M** is contribution to labour income. It is also estimated that **3,608 FTEs** were created or sustained in the Waterloo region.

In addition, it is estimated that out-of-town student expenditures generated **\$10M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the municipal government.

Figure 37: Out-of-Town Student Contribution to GDP, Labour Income and Employment in the Waterloo region (\$Millions and FTEs)

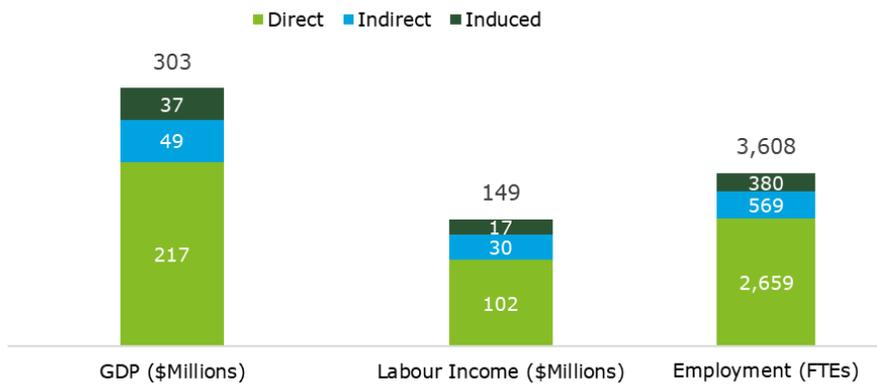
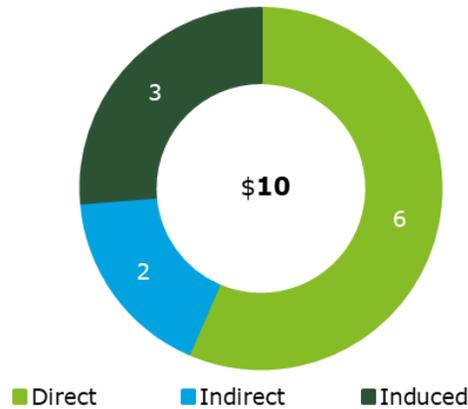


Figure 38: Out-of-Town Student Contribution to Municipal Government Revenues in the Waterloo region (\$Millions)



D.4 Breakdown of economic contribution from the University’s Co-op program

National level

Accounting for direct, indirect, and induced economic contributions, increased Co-op employer profits contributed an estimated **\$567M** to Canada's GDP, of which **\$310M** is contribution to labour income. It is also estimated that **5,779 FTEs** were created or sustained across Canada.

In addition, it is estimated that increased Co-op employer profits generated **\$138M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 39: Co-op Program Contribution to GDP, Labour Income and Employment in Canada (\$Millions and FTEs)

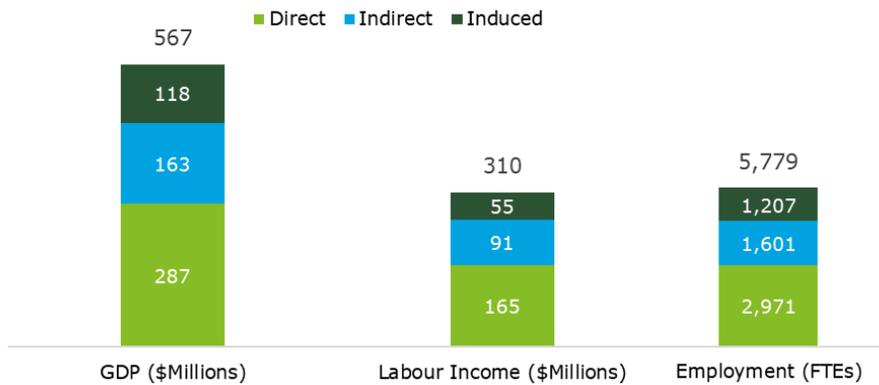
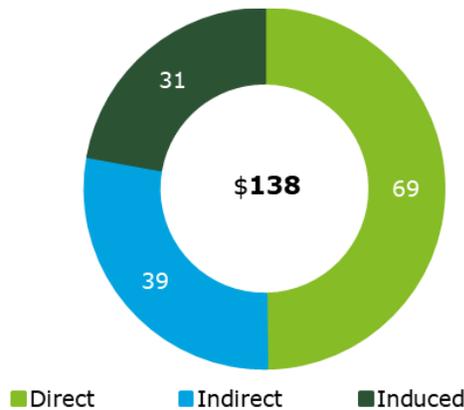


Figure 40: Co-op Program Contribution to Government Revenues in Canada (\$Millions)



Provincial level

Accounting for direct, indirect, and induced economic contributions, increased Co-op employer profits contributed an estimated **\$410M** to Ontario's GDP, of which **\$234M** is contribution to labour income. It is also estimated that **4,230 FTEs** were created or sustained in Ontario.

In addition, it is estimated that increased Co-op employer profits generated **\$92M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 41: Co-op Program Contribution to GDP, Labour Income and Employment in Ontario (\$Millions and FTEs)

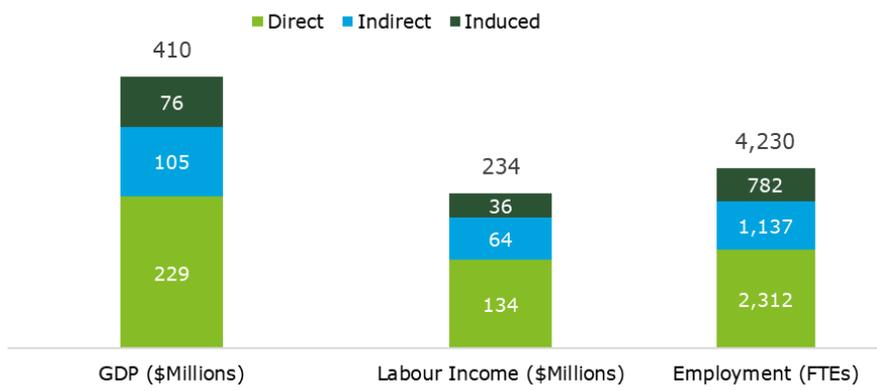
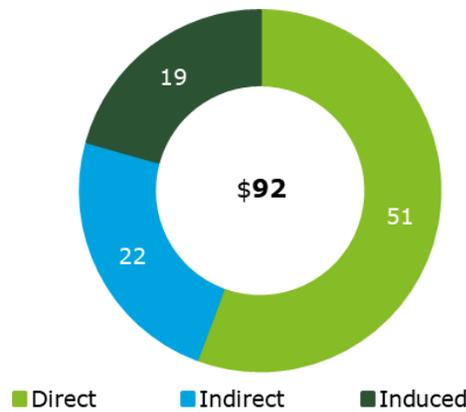


Figure 42: Co-op Program Contribution to Government Revenues in Ontario (\$Millions)



Local level

Accounting for direct, indirect, and induced economic contributions, increased Co-op employer profits contributed an estimated **\$251M** to the Waterloo region's GDP, of which **\$143M** is contribution to labour income. It is also estimated that **2,593 FTEs** were created or sustained in the Waterloo region.

In addition, it is estimated that increased Co-op employer profits generated **\$12M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the municipal government.

Figure 43: Co-op Program Contribution to GDP, Labour Income and Employment in the Waterloo region (\$Millions and FTEs)

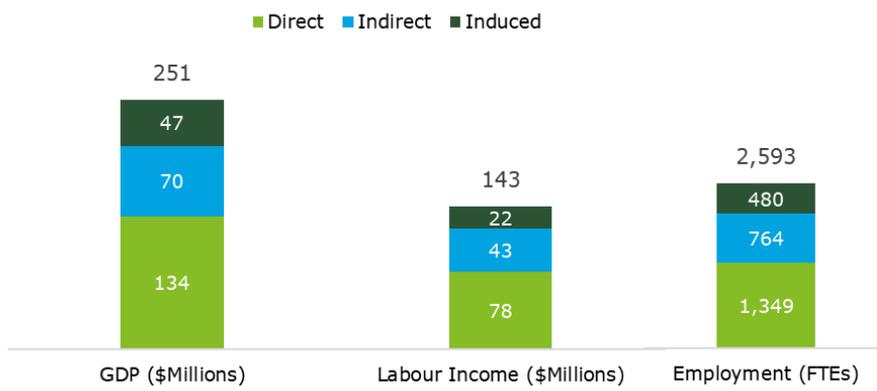
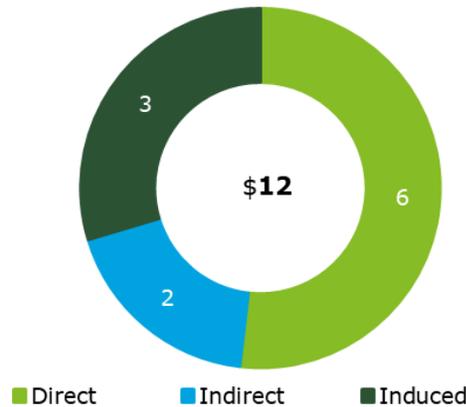


Figure 44: Co-op Program Contribution to Municipal Government Revenues in the Waterloo region (\$Millions)



D.5 Breakdown of economic contribution of companies that have spun out of the University

National level

Accounting for direct, indirect, and induced economic contributions, spin-off revenues of Velocity and Accelerator Centre alumni contributed an annual **\$172M** to Canada's GDP, of which **\$102M** is contribution to labour income. It is also estimated that **1,381 FTEs** were created or sustained across Canada.

In addition, it is estimated that spin-off revenues of Velocity and Accelerator Centre alumni generated **\$40M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 45: Contribution of Velocity and Accelerator Centre Alumni to GDP, Labour Income and Employment in Canada (\$Millions and FTEs)

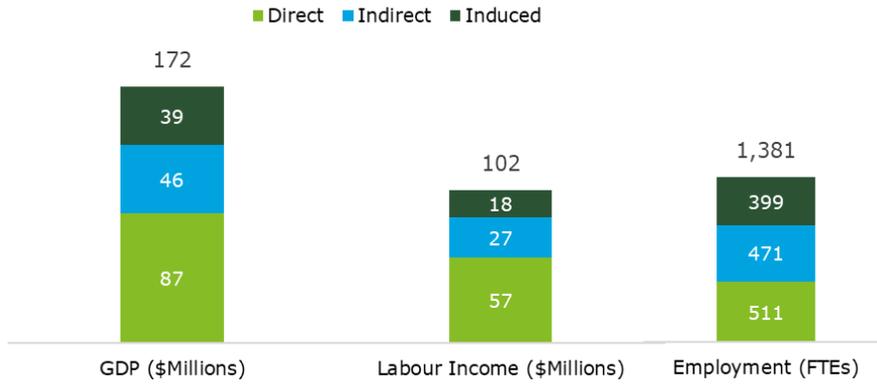
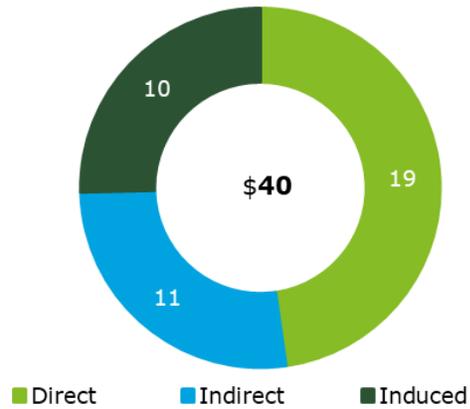


Figure 46: Contribution of Velocity and Accelerator Centre Alumni to Government Revenues in Canada (\$Millions)



Provincial level

Accounting for direct, indirect, and induced economic contributions, spin-off revenues of Velocity and Accelerator Centre alumni contributed an annual **\$124M** to Ontario's GDP, of which **\$77M** is contribution to labour income. It is also estimated that **1,000 FTEs** were created or sustained in Ontario.

In addition, it is estimated that spin-off revenues of Velocity and Accelerator Centre alumni generated **\$26M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the government.

Figure 47: Contribution of Velocity and Accelerator Centre Alumni to GDP, Labour Income and Employment in Ontario - Velocity (\$Millions and FTEs)

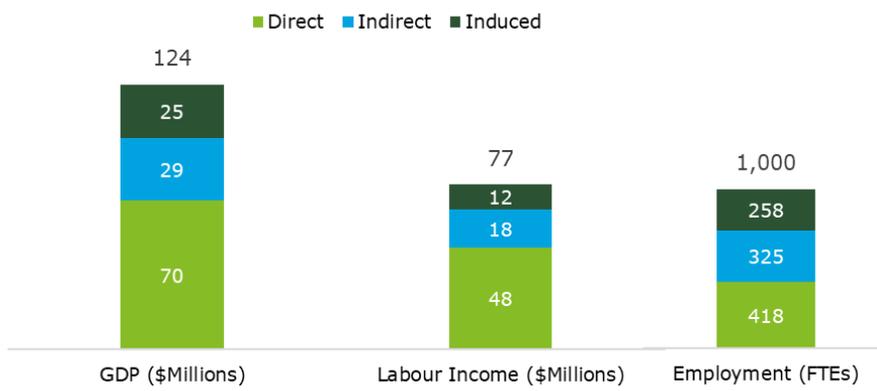
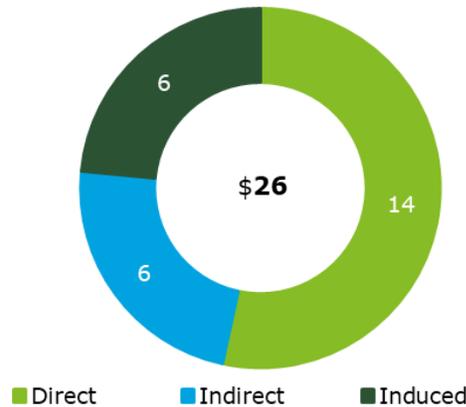


Figure 48: Contribution of Velocity and Accelerator Centre Alumni to Government Revenues in Ontario (\$Millions)



Local level

Accounting for direct, indirect, and induced economic contributions, spin-off revenues of Velocity and Accelerator Centre alumni contributed an annual **\$84M** to the Waterloo region's GDP, of which **\$53M** is contribution to labour income. It is also estimated that **670 FTEs** were created or sustained in the Waterloo region.

In addition, it is estimated that spin-off revenues of Velocity and Accelerator Centre alumni generated **\$3M** in products and production taxes, such as sales tax (GST), payroll taxes, and excise duties, corporate income taxes, and personal income taxes to the municipal government.

Figure 49: Contribution of Velocity and Accelerator Centre Alumni to GDP, Labour Income and Employment in the Waterloo region (\$Millions and FTEs)

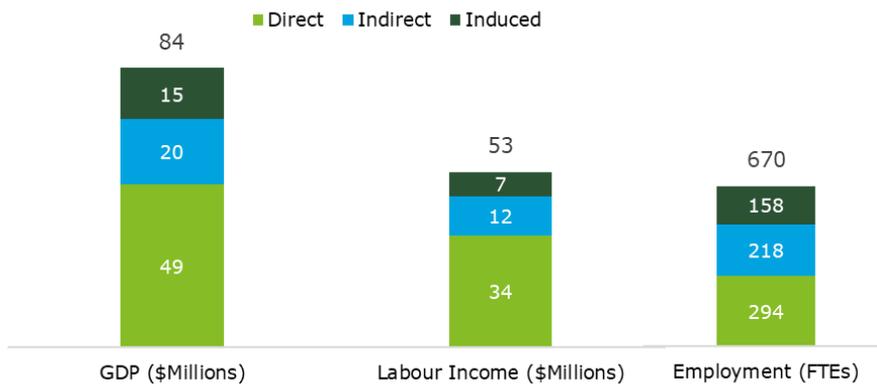
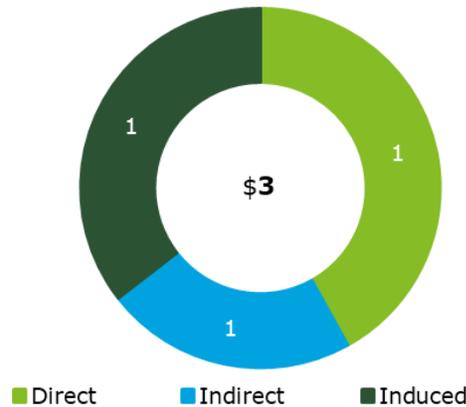


Figure 50: Contribution of Velocity and Accelerator Centre Alumni to Government Revenues in the Waterloo region (\$Millions)



D.6 Economic contribution from University research activities

To estimate the economic contribution of the University's research activities to the Ontario economy, we modified and tailored Martin and Sudmant's methodology. As this methodology differs from the one used to estimate the other impacts in the report and does not include an Input-Output model. Thus, this methodology does not enable calculation of direct, indirect and induced economic contributions.

Using the methodology detailed in Appendix C.4, Deloitte estimated the total impact of the University of Waterloo's research expenditures. Thus, we estimate that the total impact of research activities executed from 2014/15-2018/19

funded by the University on Ontario's GDP reached \$458 million in 2018/19. This methodology accounts for the fact that research undertaken in previous years can have economic benefits that are realized in the economy years later.





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