



# **Waterloo Bridge to 2020**

## **GRADUATE STUDIES**

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Issue Paper  
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## **Executive Summary**

This paper intends to summarize the work done by the Graduate Studies Issue Paper Advisory Group. The goal of this group was to identify and provide substantive background on issues facing graduate studies such that conversation can be facilitated among campus stakeholders. The summary provided here is informed by three primary sources: a wide-ranging literature review; consultation with peer universities through Education Advisory Board; and the knowledge of the Advisory Group members. Through our work, several overarching research questions evolved. Each is discussed in detail here.

### **How can Waterloo attract and retain the best graduate students, and facilitate the best support possible?**

The concept of a “student funnel” is often discussed in higher education. Conceptually, the funnel reflects the narrowing of the pool from a large number of potential applicants, to those who do apply, to those who receive offers, and finally, to those who confirm and attend. Naturally, this process is strongly influenced by student experience; those who excel at a university are likely to both generate positive recognition for the university and become ambassadors for that university, broadening the initial applicant pool. This research question intends to explore the best practices in the initial stages – marketing, recruitment, and retention – of the graduate student funnel to understand where opportunities may exist to grow Waterloo’s graduate enrollment, in both quantity and quality.

The literature review conducted for this research question suggests that most graduate students make their decisions on places to study based on the quality of the program, the potential career outcome, the affordability, and the relationship with their supervisors. Generally, digital media remains the strongest asset in marketing and recruitment (M&R); the literature is less conclusive on the use of social media. The literature also advocates for the use of data to manage the recruitment process – to identify target markets, to evaluate the success of initiatives, and to understand students’ reactions to M&R efforts. Commonly identified elements of successful M&R are communication and relationship building between (potential) applicants, programs, and supervisors. More specifically, the use of Customer Relationship Management (CRM) software as both a data analysis and a relationship monitoring tool is widely recognized.

Attrition in graduate studies is less impactful than at the undergraduate level. Data from Waterloo suggest that in the past three years, 361 Master’s students and 136 PhD students have voluntarily withdrawn. Of those withdrawing, only 27 students cited financial reasons that motivated the withdrawal. The most common reasons were personal (192), work – found job (119), program – wrong fit (103), and medical (48). According to the 2016 Canadian Graduate and Professional Student Survey (CGPSS), more than half of respondents did not identify any obstacles to their academic progress, but 25% did identify work/financial commitments as a major obstacle to their academic progress. In addition, for both the 2014/15 and 2015/16 fiscal years, Waterloo ranked first among the U15 Group of Canadian Research Universities in regards to financial support provided to both research Master's and doctoral students.

### **How can we build a distinctive approach to the graduate experience at Waterloo?**

When selecting among graduate schools, potential applicants have a host of options. It is necessary for universities to be able to differentiate themselves from peers – particularly in the area of student experience. The goal of this research question was to understand how other universities create an environment that promotes positive student experiences which, in turn, can support the initial and final stages of the funnel.

The process of identifying the issues of most importance to graduate student experience included an analysis of the results of a recent survey conducted by the Graduate Student Association (GSA). Not surprisingly, the most important issues for graduate students are space, wellness, funding, and the quality of relationship with university administrators – Faculty (including supervisors) and staff. For the first point, dedicated graduate student space and facilities are issues that have been identified in multiple forums. Best practices at peer universities include dedicated space for graduate and professional students. For example, Virginia Tech reported the creation of a Graduate Life Center, a hub providing “collaborative and study space, support services, housing and dedicated graduate programming.”

On wellness, our work coincided with a report on graduate student mental health that suggested: “that graduate students are at greater risk for mental health issues than those in the general population. This is largely due to social isolation, the often abstract nature of the work and feelings of inadequacy, not to mention the slim tenure-track job market.” (Evans et al. 2018) Our Advisory Group is eager to work with the other groups to articulate unique considerations and solutions for graduate students’ mental and overall health.

The literature also identifies that current and future graduate students are eager to engage in extensive professional development (PD) opportunities. The Canadian Association for Graduate Studies' 2008 report argues that universities are responsible for providing graduate students with the best possible preparation for their future roles, and that this responsibility extends to the development of professional skills. The report highlights four skill areas (communications skills, management skills, teaching and knowledge transfer skills, and ethics) as having a higher likelihood of implementation success in universities. A 2016 study reported that the most popular workshop session themes were found to be the following: career planning, ethics and copyright, networking and job searching, presentations and public speaking, project management, software and online branding, teaching, and writing for grad school.

In peer universities, several best practices have emerged around PD, including: introducing formal mentorship programs with influential alumni; hiring dedicated staff to concentrate exclusively on graduate student PD; creating a culture where graduate student PD is celebrated by all members of the university community; and embedding professional development opportunities in graduate students’ curricula. Professional development goals can also be achieved through formal and informal experiential learning opportunities. One peer university convenes an external industry advisory board to oversee all external graduate student issues.

Waterloo data from the Canadian Graduate and Professional Student Survey (CPGSS) indicate that 51% of respondents perceive their quality of student experience as either very good or excellent. Interestingly, about nine in ten Waterloo graduate students report good, very good or excellent interactions with staff; about eight in ten chose the

same categories for academic advising. To catalyze positive relationships between supervisors and students, several best practices have been identified. First is the recurring training of supervisors, which is mandatory at multiple peer universities. Second is the use of “supervisory agreements” that establish common expectations at the onset of the student-supervisor relationship.

Despite substantive programming through Waterloo’s GRADventure program and the Centre for Career Action, only about half of CGPSS respondents overall felt prepared to “begin a new job tomorrow.” Finally, 43.8% rated the quality of the support and training that they had received (advice/workshops) surrounding career options outside of academia to be either fair or poor.

### **How can we engage graduate students in impactful research?**

The literature suggests that students pursuing graduate studies often do so to achieve impact; they wish to make substantive changes in their fields of study. The literature also indicates that students are in some cases seeking to customize their areas of inquiry to achieve their personal goals. These observations present several opportunities, and challenges.

When a supervisor considers a student as a vehicle to advance the supervisor’s research agenda, they may devote insufficient attention to the student’s academic, professional and personal goals. This practice may stem, at least in part, from the evaluation metrics that are in place in most research intensive universities. The literature reviewed did not address the assessment of research productivity and impact from the perspective of incorporating graduate students’ goals and objectives into faculty members’ evaluations. No best practices were identified from peer universities. More research is necessary here.

Our Advisory Group also spent considerable time talking about achieving meaningful interdisciplinarity in research. The Committee on Facilitating Interdisciplinary Research and Committee on Science, Engineering and Public Policy states: “Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.” In a 2014 report for the Canadian Association for Graduate Studies, Hall outlines four types of interdisciplinary graduate programs (IDGPs) that exist in Canada: individually designed programs, direct entry programs, supplementary programs (which are called collaborative programs in Ontario, and interdisciplinary specializations in Alberta), and non-degree programs (such as certificates). Functional obstacles to interdisciplinarity include: difficulty establishing a common language among students of different backgrounds, budgetary impediments, resource allocation and funding hindrances, and program advocacy (whereby interdisciplinary programs are often seen as being in competition with the department).

One successful model is at the University of Alberta, where students have the option of completing an interdisciplinary or hybrid graduate degree. If students' research interests align with two or more academic departments, they may submit a two-page proposal to apply to work with administrators in designing a hybrid degree for themselves (students must also hold a superior academic record and significant experience in at least one of the proposed disciplines). The University of Waterloo also offers a [joint interdisciplinary](#)

[program](#), though uptake is limited. Within the context of our institution, according to the Canadian Graduate and Professional Student Survey (CGPSS) conducted in 2016, slightly less than half of Waterloo respondents (47.8%) reported feeling supported to participate in interdisciplinary work.

### Questions

- What is the appropriate size and composition of Waterloo’s graduate program?
- How can Waterloo attract and retain the best graduate students, and facilitate the best support possible?
  - Does the University community see value in prioritizing and working collectively to coordinated marketing and recruitment for graduate students?
  - If so, what is the most effective way to engage faculty, staff and alumni in the M&R process?
  - What resources are necessary to implement data-driven tools to inform M&R decisions?
- How can we build a distinctive approach to the graduate experience at Waterloo?
  - Does the University see value in allocating resources to enhancing the graduate student experience on campus?
  - If so, are the strategic objectives of student wellness, access to enhanced space, professional development, and experiential learning the appropriate priorities?
  - How should responsibilities be prioritized and distributed to advance these goals?
  - What are ways in which we can ensure that our graduate students are receiving consistent and uniform interactions with supervisors, departments and Faculties as support systems?
  - Do existing faculty metrics recognize and reward those supervisors who facilitate or catalyze both traditional and non-traditional graduate student impacts?
  - If not, is there a willingness to explore the use of novel faculty evaluation metrics that incent and reward students’ achievements?
- How can we engage graduate students more meaningfully in impactful research?
  - What challenges exist that may preclude engagement in and advancement of interdisciplinary research on campus?
  - Are there curricular or other structural changes to academic programs that can motivate, incent and reward more impactful research practices?

## **1. Introduction**

This paper is intended to stimulate conversation about and, ultimately, inform the strategic vision for graduate studies at the University of Waterloo. To this end, we begin the paper with an articulation of our perception of the important and varied goals of graduate programs and graduate students on campus. We then ask necessary questions about the relationships between the University's undergraduate and graduate enrolments in terms of both their composition and University resource allocations. Next we turn our attention to three key operational themes related to graduate studies: the attraction and retention of top graduate students, the graduate student experience, and graduate students' engagement in impactful scholarship. Discussions in each of these areas are informed by explorations of the literature and best practices identified at peer (and aspirational peer) institutions.

## **2. Context of Graduate Studies at Waterloo**

### **Why Graduate Studies?**

The Graduate Studies Issue Paper Advisory Group spent considerable time articulating members' understanding of the motivations for and impacts of graduate studies at Waterloo. For the institution, graduate students are integral to the delivery of the University's educational objectives of teaching and research. As sessional instructors, teaching assistants, laboratory instructors and in a variety of other roles, graduate students serve as educators, often as part of dynamic teaching teams involving faculty and staff. Graduate students lead and work collaboratively with their peers and faculty supervisors in the creation of new knowledge, and the development of transformative applied research outcomes. Stated succinctly, without graduate students, the University could not achieve its goals of teaching and research excellence.

Students obviously seek graduate degrees for a wide variety of personal and professional objectives. We also recognize that "graduate studies" encompass a breadth of program types – from professional, often course-based master's degrees, to research programs at the Master's and PhD levels. Despite this diversity, we believe that there are a number of common elements that motivate students' engagement in graduate studies.

Perhaps most importantly, graduate students seek to advance their academic capacities; they remain eager to learn. Graduate students also have greater opportunities to customize their academic experiences with fewer required courses, the ability to define areas of research and exploration, and the potential to engage in disparate experiential learning opportunities, to achieve their personal objectives. Undoubtedly, graduate students perceive the achievement of an advanced degree, and skill sets that are attained through that process, most notably critical thinking and in-depth problem solving, as a path to advance their professional opportunities.

Collectively, the University and the graduate student body benefit from the community to which graduate students contribute so meaningfully. At Waterloo, graduate students make up about 15% of the total student enrolment using fall 2017 headcount data. About 35% of graduate students are international, bringing cultural diversity and the opportunity for greater global awareness to the University community.



The benefits of graduate studies are not limited to the University or its students. Indeed, those completing graduate programs are well-equipped to be impactful leaders locally, nationally and globally. These graduates and their research outputs create transformative change in all sectors – economy, society and environment.

**What is the appropriate size and composition of Waterloo’s graduate program?**

Graduate students make up about 13% of the total student enrolment at the University of Waterloo, using Full Time Equivalents. (University of Waterloo, Key Performance Indicators, 2017). In other words, there are approximately 6.6 undergraduate FTEs for every graduate FTE. These data are not inconsistent with other Canadian universities. Graduate percentages at Canada’s U15 schools range from 13% to 26% (U15 Data Exchange, Internal data, 2017).

Research intensive universities in other parts of the world tend to have much higher percentages of graduate students. Stanford and MIT have 56% and 60% graduate students respectively. Globally, Imperial College London is 41% graduate while ETH in Zurich is 52% graduate students. Generally, it is understood that higher ratios of graduate students to total students are indicative of greater research productivity.

As noted above, Waterloo’s graduate program has about 35% international students, among the highest in the U15. For comparison, the U15 average is about 24%.

This enrolment balance has resource implications. Naturally, faculty members have a limited number of teaching tasks, the majority of which, given the distribution of student enrolment, are dedicated to undergraduate teaching. Teaching loads also influence a faculty member’s ability to effectively supervise research graduate students. Research graduate students also receive funding from a combination of sources – their supervisors, their home departments or Faculties, as well as external agencies. Graduate students are provided with space on campus. Domestic graduate students generate substantial provincial funding in the form of Weighted Grant Units (formerly BIUs); a domestic doctoral candidate is supported by the province at a rate of up to six times that of a domestic undergraduate student. Hence, establishing and meeting domestic graduate enrolment targets are critical to the University’s revenue streams.

As the University enters the next strategic planning cycle, the Advisory Group believes there is value in articulating a vision for the desired graduate enrolment numbers, considering the composition of the student body – course based master’s, research master’s and PhD enrolment as well as domestic and international enrolment. The Advisory Group considered what the appropriate enrolment levels for graduate students – professional and research, masters and PhD, international and domestic – should be. This consideration should be cognizant of the implications on research intensity,

| <b>Graduate studies at a glance</b>                    |  |
|--|--|
| <b>Total graduate enrolment</b>                        | 5,827<br>4,599 FTE                                   |
| <b>Master's students</b>                               | 3,800 total<br>1,183 international<br>2,617 domestic |
| <b>PhD students</b>                                    | 2,027 total<br>920 international<br>1,007 domestic   |
| <b>Enrolment by Faculty</b>                            |  |
| AHS  | 734  |
| Arts   | 770  |
| Engineering  | 2,062  |
| Environment  | 586  |
| Math   | 999  |
| Science  | 641  |
| <b>Total degrees granted*</b>                          | 1,987  |
| Source: IAP, Fall 2017<br>* (3 year average 2014-2016) |  |

teaching and supervisory capacities, funding availability, as well as the need for facilities dedicated to graduate students.

Having articulated the important roles that graduate students play on campus, and the need to establish and meet meaningful targets, the Advisory Group turned its attention to "operationalizing" the achievement of goals. These included: attracting and retaining the largest possible pool of highly-qualified applicants and students; providing graduate students with the most positive experience, including opportunities to achieve individually-defined personal and professional objectives; and engaging students in transformative and impactful research. Each of these questions is explored in detail below.

### **3. Issue definition and discussion**

#### **How can Waterloo attract and retain the best graduate students, and facilitate the best support possible?**

The concept of a "student funnel" is often discussed in higher education. Conceptually, the funnel reflects the narrowing of the pool from a large number of potential applicants, to those who do apply, to those who receive offers, and finally to those who confirm and attend. Naturally, this process is strongly influenced by student experience; those who excel at a university are likely to both generate positive recognition for the university and become ambassadors for that university, broadening the initial applicant pool. This research question intends to explore the best practices in the initial stages – marketing, recruitment, and retention – of the graduate student funnel to understand where opportunities may exist to grow Waterloo's graduate enrolment, in both quantity and quality.

The literature review conducted for this research question suggests that most graduate students make their decisions on places to study based on the quality of the program, the potential career outcomes, the affordability and the relationship with their supervisors. Generally, digital media remains the strongest asset in marketing and recruitment (M&R). In a 2012 study conducted by Noel-Levitz and the National Association of Graduate Admissions Professionals (NAGAP), social media was not perceived as effective in actually generating or encouraging application inquiries; however, they did still recommend integrating social media into a multi-faceted system of ongoing recruitment and communications.

The literature also advocates for the use of data to manage the recruitment process – to identify target markets, to evaluate the success of initiatives, and to understand students' reactions to M&R efforts. Commonly identified elements of successful M&R are communication and relationship building between (potential) applicants, programs and supervisors. More specifically, the use of Customer Relationship Management (CRM) software as a tool for both data analysis and relationship monitoring is widely recognized. Hanover Research advocates the use of such data and reporting tools for academic units in their tracking and evaluating initiatives.

Denecke et al. suggest that professional development skills should be translated into recruitment information and aligned with potential career opportunities (both inside and outside of the academy). As one example, since a large proportion of students in the physical sciences may work in industry positions after graduation, Chiose proposes that

possible industry partnership experiences be emphasized as a recruitment strategy. In addition, alumni engagement can also be helpful during the recruitment process.

Graduate students value positive relationships with faculty members as well, and these relationships can begin as early as the recruitment phase. Galardi explains that many of the same support services that prove helpful to student satisfaction could also potentially assist in recruitment initiatives. Along the same lines, developing positive faculty relationships (including with supervisors and with industry partners) can begin during the recruitment phase as well.

While attrition in graduate studies is less impactful than at the undergraduate level, careful attention should be paid to the reasons why graduate students choose to leave their programs. Brill et al. outline reported reasons for doctoral attrition, which include personal issues, the nature of the doctoral program, financial considerations, emotional stress, and family obligations. Doctoral students often identify a sense of isolation and confusion about their programs; more clearly communicated expectations about graduate school processes and benefits could reduce subsequent withdrawal rates.

An effective mentoring relationship between supervisors and students is also critical for student retention, as is social engagement. The literature reviewed indicates that students who feel like part of a cohort tend to be more successful and that mentoring at the group level can heighten motivation to learn and to succeed. Additionally, student networking provides an environment that is conducive to team building, social interactions, shared learning and, ultimately, graduate success. Thus, faculty, departments and supervisors should encourage social supports and socialization activities within a graduate program; Bagaka et al. provide examples like collaboration, personal interaction, joint conference attendance, and small group meetings.

Waterloo data suggest that, in the past three years, 361 Master's students and 136 PhD students have voluntarily withdrawn. Of those withdrawing, only 27 students cited financial reasons that motivated the withdrawal. The most common reasons were instead personal (192), work – found job (119), program – wrong fit (103), and medical (48) (University of Waterloo, Graduate Student and Postdoctoral Affairs, Internal Data, 2018). According to the 2016 CGPSS, more than half of respondents did not identify any obstacles to their academic progress, but one-quarter did identify work/financial commitments as a major obstacle to their academic progress. In addition, for both the 2014/15 and 2015/16 fiscal years, Waterloo ranked first among the U15 Group of Canadian Research Universities in regards to financial support provided to both research Master's and doctoral students. (U15 data, Graduate Studies, Internal data, 2017)

To review, best practices from the literature describe a well-defined digital media strategy that emphasizes key attributes of graduate programs: the quality of the program, the strength of the supervisory experience, the potential for professional development and job opportunities, and alumni engagement. The literature scan and best practice review also pointed to the use of data and analysis to inform the enrolment process. Attrition at the graduate level should be closely monitored as well.

The Advisory Group recognizes that while the University engages in some of these best practices, opportunities exist for improvement. *The Advisory Group seeks guidance on the University community's willingness to prioritize and work collectively in allocating resources to coordinated marketing and recruitment; the engagement of faculty, staff*

*and alumni more meaningfully in the M&R process; the implementation of data driven tools to inform M&R decisions; and data gathering and analysis for attrition.*

### **How can we build a distinctive approach to the graduate experience at Waterloo?**

When selecting among graduate schools, potential applicants have a host of options. It is necessary for universities to be able to differentiate themselves – particularly in the area of student experience – from peers. The goal of this research question was to understand how other universities create an environment that promotes positive student experiences, which in turn can support the initial and final stages of the funnel.

The process of identifying the issues of most importance to graduate student experience included an analysis of the results of a recent survey conducted by the Graduate Student Association (GSA). Not surprisingly, the most important issues for graduate students are space, wellness, funding, and the quality of relationship with university administrators – faculty (including supervisors) and staff. For the first point, dedicated graduate student space and facilities are issues that have been identified in multiple forums. Best practices at peer universities include dedicated space for graduate and professional students. For example, Virginia Tech reported the creation of a Graduate Life Center, a hub providing "collaborative and study space, support services, housing and dedicated graduate programming."

On wellness, our work coincided with a report on graduate student mental health that suggested "that graduate students are at greater risk for mental health issues than those in the general population. This is largely due to social isolation, the often abstract nature of the work and feelings of inadequacy – not to mention the slim tenure-track job market." (Evans et al. 2018) Our Advisory Group is eager to work with the other advisory groups to articulate unique considerations and solutions for graduate students' mental and overall health. A roundtable that was conducted with Waterloo graduate students showed that many of them currently hesitate to seek mental health services due to the lack of anonymity, as they risk running into the undergraduate students that they teach.

The literature also identifies that current and future graduate students are eager to engage in extensive professional development (PD) opportunities. The Canadian Association for Graduate Studies' (CAGS) 2008 report argues that universities are responsible for providing graduate students with the best possible preparation for their future roles, and that this responsibility extends to the development of professional skills. The report highlights four skill areas (communications skills, management skills, teaching and knowledge transfer skills, and ethics) as having a higher likelihood of implementation success in universities. Furthermore, a 2016 CAGS study found that the most popular workshop session themes were career planning, ethics and copyright, networking and job searching, presentations and public speaking, project management, software and online branding, teaching, and writing for grad school.

In peer universities, several best practices have emerged around PD, including: introducing formal mentorship programs with influential alumni, hiring dedicated staff to concentrate exclusively on graduate student PD, creating a culture where graduate student PD is celebrated by all members of the university community, and embedding professional development opportunities in graduate students' curricula. Professional development goals can also be achieved through formal and informal experiential

learning opportunities. One peer university convenes an external industry advisory board to oversee all external graduate student issues.

The career path for graduate students is not as clear as it once was. The number of Canadian PhD graduates who secure an academic job is decreasing and was estimated to be less than 20%, according to a panel of scientists at the Canadian Science Policy Conference in 2011. Many of our students will thus undertake careers outside of the academy. As a result, Charbonneau (2011) suggests the inclusion of more internship opportunities within programs, in domains such as industry, government or non-profit.

As examples, Charbonneau (2011) mentions that more than two-thirds of PhD students in the Netherlands hold internships, and for Germany, Spain, and the UK these numbers are 55%, 30%, and 23%, respectively. Within this framework of work-integrated learning (where students learn in a real-world context, but also receive course credit), Henderson and Trede emphasize the importance of collaborative governance, due to the fact that a major challenge with work-integrated learning is ensuring that students are still receiving a quality experience while they are outside of the university campus. Given the University's long track record with cooperative education at the undergraduate level, the Advisory Group saw great promise in extending these opportunities to graduate students, helping to achieve their post-graduation preparedness.

For research graduate students, the most important relationship is with the student's supervisor(s). Halbert refers to the graduate student/supervisor relationship as a learning alliance that strives for common goals and, as such, stresses the importance of certain elements: regular meetings, providing appropriate feedback, an early understanding of expectations (possibly in the form of a contract), sustained engagement from the supervisor, and a good personal relationship.

On the contrary, a primary strain appears to be the increased pressure that is placed on supervisors for performance, accountability, and timeliness — namely, according to Halbert, the "pressure to yield knowledge in forms that count and in timelines that fit with relatively newly created and tight boundaries." Supervisors are thus forced to navigate a variety of tensions, including providing enough autonomy for the doctoral candidate to be able to undertake independent research while still ensuring that his or her timelines are met, all while also "finding the space amongst a myriad of demands to develop an effective relationship."

Due to the changing conditions of supervision and research funding, McCallin and Nayar propose ideas geared to improving the graduate student/supervisor relationship, including supervisory training as well as basic research training for students (aimed to alleviate supervisors) on topics like literature reviews, research design, thesis writing, paper presentation, and publication. It is to be noted that they utilize the rate of degree completion (median time) as their measure of effective supervision. Similarly, Galt explains that the Dean of Graduate Studies at McGill University has implemented workshops for postdoctoral fellows in order to train them to be supervisors, as well as doctoral writing groups intended to improve outputs for PhD students. A roundtable conducted with postdoctoral fellows at Waterloo in February 2018 showed that our postdoctoral fellows do want the opportunity to mentor graduate students. Our Advisory Group also noted that the University currently offers a set of supervisory training courses

that are one way to satisfy the conditions necessary to be granted Approved Doctoral Dissertation Supervisor (ADDS) status.

Data from the University's 2016 CPGSS results indicate that 51% of respondents perceive their quality of student experience as either very good or excellent. Interestingly, about nine in 10 Waterloo graduate students report good, very good or excellent interactions with staff; about eight in 10 chose the same categories for academic advising. Despite substantive programming through Waterloo's GRADventure program and the Centre for Career Action, only about half of CPGSS respondents overall felt prepared to "begin a new job tomorrow" in a non-academic private/public sector, and as a researcher in their field. Finally, 44% rated the quality of the support and training that they had received (advice/workshops) surrounding career options outside of academia as being either fair or poor.

To summarize, the Advisory Group recognizes that there are very positive elements of the student experience at Waterloo, but opportunities exist for improvement. *The research and our own student feedback suggests that space and wellness resources for graduate students may improve student experience. Moreover, greater emphasis on professional development and experiential learning – an obvious strength of the University given its unmatched depth of relationships with external partners – may enhance student experience. Finally, the roles of supervisors, departments and Faculties may warrant review to ensure that students are experiencing consistently and uniformly interactions with colleagues.*

*Based on this review, the Advisory Group again seeks guidance on how to prioritize and distribute responsibilities to achieve many of these goals. How do we put in place resources and motivate practices to advance graduate student experiences?*

### **How can we engage graduate students in impactful research?**

The literature suggests that students pursuing graduate studies often do so to achieve impact – they wish to make substantive changes in their fields of study. The literature also indicates that students are in some cases seeking to customize their areas of inquiry to achieve their personal goals. These observations present several opportunities, and challenges.

There exists a perceived dichotomy that can arise when a supervisor considers a student as a vehicle to advance the supervisor's research agenda. In these cases, the situation may occur where insufficient attention is paid to the student's academic, professional and personal goals. This practice may stem, at least in part, from the evaluation metrics that are in place in most research intensive universities. The literature reviewed did not address the assessment of research productivity and impact from the perspective of incorporating graduate students' goals and objectives into faculty members' evaluations.

In terms of faculty work, Gillman et al. suggest moving away from an individualistic approach towards a more holistic one. They provide three major conclusions: academic departments require the flexibility to support differential work by its members, the faculty workload must be defined in ways beyond credit hours taught in order to justly include all areas of faculty involvement, and "faculty evaluation must recognize that the expanding definitions of teaching, scholarship, and service necessitate a more flexible and holistic approach to evaluation." Their holistic department model "is committed to a culture that supports faculty members' mentoring each other as well as its students, and

it has a deep sense of shared obligations to students, its members, and the institution." As a result, the goal becomes to advance overarching institutional goals, rather than to prioritize the objectives of individual faculty members.

Our Advisory Group also spent considerable time talking about achieving meaningful interdisciplinarity in research. This is also addressed in the *Research Issue Paper*. The Committee on Facilitating Interdisciplinary Research states: "Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice." In a 2014 report for the Canadian Association for Graduate Studies, Hall outlines four types of interdisciplinary graduate programs (IDGPs) that exist in Canada: individually designed programs, direct entry programs, supplementary programs (which are called collaborative programs in Ontario, and interdisciplinary specializations in Alberta), and non-degree programs (such as certificates). Functional obstacles to interdisciplinarity include: the difficulty in the establishment of a common language among students of different backgrounds, budgetary impediments, resource allocation and funding hindrances, and program advocacy (whereby interdisciplinary programs are often seen as being in competition with the department).

One successful model is at the University of Alberta, where students have the option of completing an interdisciplinary or hybrid graduate degree; if students' research interests align with two or more academic departments, they may submit a two-page proposal to apply to work with administrators in designing a hybrid degree for themselves (students must also hold a superior academic record and significant experience in at least one of the proposed disciplines). The University of Waterloo also offers a [joint interdisciplinary program](#), though uptake is limited. Within the context of our institution, according to the CGPSS conducted in 2016, slightly less than half of Waterloo respondents (48%) reported feeling supported to participate in interdisciplinary work.

To summarize, the Advisory Group sees important potential for graduate students to not only advance the University's research initiatives, but to determine their own paths towards impact. *To this end, the Advisory Group seeks guidance as to appropriate faculty metrics that may recognize and reward those supervisors who facilitate or catalyze both traditional and non-traditional graduate student impacts. Is there a willingness to explore the use of novel faculty evaluation metrics that incent and reward students' achievements?*

The Advisory Group also recognizes the benefits and perceived challenges to achieving more widespread interdisciplinarity in graduate student research. *As such, the Advisory Group seeks guidance on how to achieve this outcome. Are there curricular or other structural changes to academic programs that can motivate, incent and reward more impactful research practices?*

## **4. Interactions with other issue papers**

The Advisory Group acknowledges a plethora of overlapping questions and considerations with many, if not all, of the other six issue papers intended to inform the

2020 strategic plan – in particular, *Research Excellence* and *Empowering People*. We will address below the most relevant areas of interaction that exist in each one.

The paper on *Research Excellence*, like this one, discusses the question of how to engage graduate students in meaningful and impactful research, both discipline-specific and cross-Faculty interdisciplinary collaboration (as well as the challenges surrounding defining what that really looks like). Many of the same barriers are outlined in regards to pursuing interdisciplinary research: budget and funding constraints, allocation of space and other resources, a stigma surrounding its perceived lack of value, and merit evaluation guidelines for faculty members. These issues thus overlap: how important is cross-Faculty interdisciplinary research, and how can we best overcome the obstacles that currently exist in terms of fostering and supporting it?

Secondly, the paper on *Empowering People* addresses all individuals who are a part of the Waterloo community and reflects upon what empowerment would look like for each group. Their discussion of empowered graduate students and postdoctoral fellows includes mention of instilling confidence, and fostering passion and engagement surrounding meaningful learning and development that extends post-graduation. A few overlapping suggestions include consistent faculty recognition, increased high-quality wellness programming, mentorship opportunities, and taking a holistic approach to student support.

As we strive to understand the appropriate balance between international and domestic graduate students, the paper on *Internationalization* also addresses the issue of pinpointing where to focus Waterloo's international efforts. The *Leveraging Resources* paper reflects upon space management and physical infrastructure in relation to improving the student experience – in our case, dedicated spaces for graduate and professional students has indeed been named as a priority. The paper on *Undergraduate Learning* highlights the importance of enhancing experiential learning as an integral part of the Waterloo experience: supporting instructors, reshaping pedagogy, developing meaningful measures of assessing impact, etc. Finally, the paper on *Student Learning Environment* aligns with our objective to provide graduate students with the best experience possible; this Advisory Group outlines issues surrounding achieving a positive learning experience, supporting students, and increasing retention rates.

## **5. Questions for the community**

In developing a new strategic plan for Waterloo, the Graduate Studies Issue Paper Advisory Group encourages collaborative reflection and engagement from the University community in prioritizing and guiding our objectives moving forward, a process to be informed by the following questions for consultation.

**What is the appropriate size and composition of Waterloo's graduate program?**

**How can Waterloo attract and retain the best graduate students, and facilitate the best support possible?**

- Does the University community see value in prioritizing and working collectively to coordinated marketing and recruitment for graduate students?



- If so, what is the most effective way to engage faculty, staff and alumni in the M&R process?
- What resources are necessary to implement data-driven tools to inform M&R decisions?

**How can we build a distinctive approach to the graduate experience at Waterloo?**

- Does the University see value in allocating resources to enhancing the graduate student experience on campus?
- If so, are the strategic objectives of student wellness, access to enhanced space, professional development, and experiential learning the appropriate priorities?
- How should responsibilities be prioritized and distributed to advance these goals?
- What are ways in which we can ensure that our graduate students are receiving consistent and uniform interactions with supervisors, departments and Faculties as support systems?
- Do existing faculty metrics recognize and reward those supervisors who facilitate or catalyze both traditional and non-traditional graduate student impacts?
- If not, is there a willingness to explore the use of novel faculty evaluation metrics that incent and reward students' achievements?

**How can we engage graduate students more meaningfully in impactful research?**

- What challenges exist that may preclude engagement in and advancement of interdisciplinary research on campus?
- Are there curricular or other structural changes to academic programs that can motivate, incent and reward more impactful research practices?

## Appendix A: Issue paper process and methodology

To begin the issue paper process, the president, provost, deans, and other members of the Executive Council identified broad themes and issues vital to strengthening and advancing the unique value proposition for the University of Waterloo. The Executive Council identified faculty and staff to lead this initiative, while the Graduate Student Association and identified graduate undergraduate student representatives.

Through a series of meetings between January and May 2018, the Graduate Studies Issue Paper Advisory Group defined the issue, developed a literature scan strategy supported by the Waterloo library, summarized the literature, provided input and feedback to the drafts, and developed the final consultation questions. This paper reflects the process engaged by this advisory group and is not intended to be a comprehensive overview of every issue pertaining to graduate studies at Waterloo. The Advisory Group spent considerable time reflecting upon and outlining how to prioritize a vision for graduate studies moving forward.

Outlined below is the original list of research questions (in no particular order of importance) compiled by the group that initially guided this process. Based on the data and research gathered as well as collective objectives, these were then narrowed into the overarching questions that were ultimately discussed in the main body of this paper.

1. What are the best practices in enhancing a robust research program through graduate studies?
  - a. What does interdisciplinary work mean for graduate students?
  - b. What are the barriers that prevent faculty members from working effectively with students?
  - c. What are the obstacles for creating a robust research program? What are the best principles that guide our evaluation of research impact? What is the impact on students, supervisors, and the research community?
2. How can Waterloo attract and retain the best graduate students, and facilitate the best support possible?
  - a. What are the best practices in graduate student marketing, recruitment, confirmation, and retention strategies?
  - b. What are the relationships in terms of the balance of undergrad and grad students to the level of research intensity (as measured by research funding per faculty member) at peer universities? Is there a relationship between the balance of domestic and international graduate student and research intensity?
  - c. What are the principles that guide financial incentive for graduate student recruitment? How do other universities approach this? What are the best practices?
3. How can we build a distinctive Waterloo approach to the graduate experience at Waterloo?
  - a. What have been identified as the most important types of supports leading to positive graduate student experiences?

- b. In terms of graduate student satisfaction, is there evidence that identifies the most impactful points of contact for students (supervisors, department coordinators, senior administrators, peers, etc.)?
  - c. What are effective incentives for faculty members to consider graduate students' objectives when supervising or mentoring? What are commonly identified (institutional, cultural, professional) barriers that dissuade faculty members from working effectively with students?
4. What are the best practices in building non-academic pathways for graduate students, which may include co-op and other non-academic experiences?
- a. How do graduate students' activities include professional development or extra-curricular pathways or experiential components that optimally prepare them for the work force?
  - b. What are the best practices in incorporating non-traditional curricular options, such as work-integrated learning, in PhD programs?
  - c. What tradeoffs have been realized and accepted in terms of delaying times to completion or reducing students' production of traditional scholarly outputs?
  - d. What are the best practices in implementation of professional development training for PhD students?
  - e. Have universities developed evaluation metrics for faculty members that recognize non-traditional research outputs that support students' attainments of their goals?

The methodology utilized was developed not to create a comprehensive understanding of graduate studies, but rather to highlight and explore the most important issues identified by key University stakeholders in order to inform the upcoming consultation process. The Graduate Studies Issue Paper Advisory Group considered information collected from a variety of sources:

- University survey data on graduate studies, analyzed and reported by Waterloo's Institutional Analysis and Planning unit (IAP)
- A summary of interviews with peer university stakeholders to address key issues within graduate studies, developed by the Educational Advisory Board (EAB)
- A literature scan and synthesis conducted by Waterloo's library staff based on the above research questions
- Internal data from the Office of Graduate Studies and Postdoctoral Affairs (GSPA)
- Roundtable discussions between the president and groups of Waterloo graduate students and Waterloo postdoctoral fellows

## **Appendix B: Detailed literature scan methods**

The bulk of the literature search focused on the database ERIC, with additional searching in SCOPUS and Google Scholar. Reference searching was also conducted on pertinent articles. The decision was made to look at materials published between 2008 and the present, worldwide, written in English. This scope ensured that the more recent research and thinking in higher education would be represented. The nature of the questions meant that they were searched separately, using search terms and strategies specific to the theme of the question.

A variety of sources were identified of possible interest to the working group. Literature reviews and meta-analyses were a primary focus, but studies and key reports were also identified. Dissertations were generally excluded except for those germane to the topic. Materials and key contacts were recommended by members of the working group. Content from these recommended sources was also included.

### **Strengths**

Grey literature was a key strength for this group; many of the foundational documents came from sources such as the Council of Graduate Schools, the Canadian Association for Graduate Studies, and the Conference Board of Canada.

A great deal of research has been done on the impact of graduate supervision on student experience, including the impact on marketing, retention, and completion.

Professional skills programs are bountiful across North American institutions, and information about these, and research in this area is plentiful.

### **Limitations**

The process of determining what the most important aspects of graduate studies to investigate, which factors of those were relevant, and which research questions should be asked was limited to the perspectives of the working group. What is presented in this paper is not comprehensive, and may not be applicable outside of the institutional context of the University of Waterloo.

Some questions focused on data that may be viewed as confidential/internal marketing strategies at other institutions. As a result of these issues, drawing conclusions about best practices is difficult. However, this represents an opportunity for innovation and future research.

Many of the research questions focus on the relationship between faculty members and graduate students. Although there is much available on the faculty-student relationship as it impacts the student, there is a gap in the literature as it impacts the faculty member. The effect of institutional practices is even farther removed.

Though literature reviews and meta-analyses were actively sought, they were difficult to find in most of the search areas. Single studies and grey literature reports comprised most of the literature found, and as such may not be directly applicable to Waterloo.

## References

- Amundsen C. & McAlpine, L. (2009). "Learning Supervision": Trial by Fire. *Innovations in Education and Teaching International*, 46(3), 331-342.
- Arnsperger, A., & Drivalas, J. (2016). Students Speak about Faculty: What Students Need, What They Want, and What Helps Them Succeed. In A. Kezar & D. Maxey (Eds.), *Envisioning the Faculty for the Twenty-First Century: Moving to a Mission-Oriented and Learner-Centered Model* (101-116). New Jersey, NY: Rutgers University Press.
- Bagaka, J. G., Badillo, N., Bransteter, I., & Rispinto, S. (2015). "Exploring Student Success in a Doctoral Program: The Power of Mentorship and Research Engagement." *International Journal of Doctoral Studies*, 10, 323-342.
- Bøgelund, P. (2015). How Supervisors Perceive PhD Supervision – And How They Practice It. *International Journal of Doctoral Studies*, 10, 39-55.
- Borrego, M., Boden, D., & Newswander, L. K. (2014). Sustained Change: Institutionalizing Interdisciplinary Graduate Education. *The Journal of Higher Education*, 85(6), 858-885.
- Brill, J. L., Balcanoff, K. K., Land, D., Gogarty, M., & Turner, F. (2014). Best Practices in Doctoral Retention: Mentoring. *Higher Learning Research Communications*, 4(2), 26-37.
- Canadian Association for Graduate Studies. (2014). *Interdisciplinary Graduate Programs in Canada: Practice and Potential*. Retrieved from <http://www.cags.ca/documents/publications/working/IDGPs%20FINAL%20report%20revised.APPROUVED.pdf>
- Canadian Association for Graduate Studies. (2008). *Professional Skills Development for Graduate Students*. Retrieved from <http://www.cags.ca/documents/publications/working/Prof%20Skills%20Dev%20for%20Grad%20Stud%20%20Final%2008%2011%2005.pdf>
- Canadian Council of Graduate Schools. (2014). *Principles for Supporting Interdisciplinarity in (Post)graduate Education and Research*. Retrieved from [http://cgsnet.org/ckfinder/userfiles/files/2014\\_Global\\_Summit\\_Principles.pdf](http://cgsnet.org/ckfinder/userfiles/files/2014_Global_Summit_Principles.pdf)
- Charbonneau, L. (2011, November 30). Is Canada producing too many PhDs? Yes, no and maybe. *University Affairs*. Retrieved from <http://www.universityaffairs.ca/news/news-article/is-canada-producing-too-many-phds>
- Chiose, S. (2018, February 1). Study of University of Toronto PhD graduates finds few end up in private sector. *The Globe and Mail*. Retrieved from <http://www.theglobeandmail.com/news/national/study-of-university-of-toronto-phd-graduates-finds-few-end-up-in-private-sector/article37813493/>
- Conference Board of Canada. (2014). *Skills and Higher Education in Canada: Towards Excellence and Equity*. Retrieved from [http://canada2020.ca/wp-content/uploads/2014/05/2014\\_Canada2020\\_Paper-Series\\_Education\\_FINAL.pdf](http://canada2020.ca/wp-content/uploads/2014/05/2014_Canada2020_Paper-Series_Education_FINAL.pdf)

- DeClou, L. (2016). Who Stays and For How Long: Examining Attrition in Canadian Graduate Programs. *Canadian Journal of Higher Education*, 46(4), 174-198.
- Denecke, D., Feaster, K., & Stone, K. (2017). *Professional Development: Shaping Effective Programs for STEM Graduate Students*. Washington, DC: Council of Graduate Schools.
- Edge, J., & Munro, D. (2015). *Inside and Outside the Academy: Valuing and Preparing PhDs for Careers*. Ottawa, ON: Conference Board of Canada.
- Evans, T.M., Bira, L., Beltran Gastelum, J., Weiss L.T., & Vanderford, N.L. (2018). "Evidence for a mental health crisis in graduate education." *Nature Biotechnology* 36, 282–284.
- Faupel-Badger, J., Raue, K., Nelson, D. E., & Tsakraklides, S. (2015). Alumni Perspectives on Career Preparation during a Postdoctoral Training Program: A Qualitative Study. *CBE Life Sciences Education*, 14(1), 1-8.
- Ford, L., & Vaughn, C. (2011). Working Together More than Alone: Students' Evolving Perceptions of Self and Community within a Four-Year Educational Administration Doctoral Cohort. *The Qualitative Report*, 16(6), 1645-1668.
- Galardi, K. M. (2012). Importance of Support Services for On- and Off- Campus Graduate Students (Dissertation). Retrieved from ERIC (1413416844; ED544149).
- Gill, P., & Bernard, P. (2008). The Student-Supervisor Relationship in the PhD/Doctoral Process. *British Journal of Nursing*, 17(10), 668-71.
- Gillman, R. A., Hensel, N., & Salomon, D. A. (2016). A New Paradigm for Faculty Work and Evaluation. In A. Kezar & D. Maxey (Eds.), *Envisioning the Faculty for the Twenty-First Century: Moving to a Mission-Oriented and Learner-Centered Model* (143-156). New Jersey, NY: Rutgers University Press.
- Grant, M. (2016). *Aligning Skills Development with Labour Market Need*. Retrieved from <http://www.conferenceboard.ca/e-library/abstract.aspx?did=7926>
- Halbert, K. (2015). Students' Perceptions of a "Quality" Advisory Relationship. *Quality in Higher Education*, 21(1), 26-37.
- Hanover Research. (2014). *Best Practices in Graduate Student Recruitment*. Retrieved from <http://www.hanoverresearch.com/media/Best-Practices-in-Graduate-Student-Recruitment-1.pdf>
- Henderson, A., & Trede, F. (2017). Strengthening Attainment of Student Learning Outcomes during Work-Integrated Learning: A Collaborative Governance Framework Across Academia, Industry and Students. *Asia-Pacific Journal of Cooperative Education*, 18(1), 73-80.
- Holley, K. (2012). Doctoral Student Socialization in Interdisciplinary Fields. In S. K. Gardner & P. Mendoza (Eds.), *On Becoming a Scholar: Socialization and Development in Doctoral Education* (97-112), Sterling, VA: Stylus Press.

- Holley, K. A., & Caldwell, M. L. (2012.) The Challenges of Designing and Implementing a Doctoral Student Mentoring Program. *Innovative Higher Education*, 37(3), 243-253.
- Kezar, A., & Maxey, D. (2014). *An Examination of the Changing Faculty: Ensuring Institutional Quality and Achieving Desired Student Learning Outcomes*. Retrieved from [http://pullias.usc.edu/wp-content/uploads/2014/01/CHEA\\_Examination\\_Changing\\_Faculty\\_2013.pdf](http://pullias.usc.edu/wp-content/uploads/2014/01/CHEA_Examination_Changing_Faculty_2013.pdf)
- Lypka, C., & Mota, M. H. R. (2017). *Graduate Professional Development: Towards a National Strategy: Phase 1*. Retrieved from [http://profdevprof.cags.ca/documents/Phase1\\_English.FINAL.pdf](http://profdevprof.cags.ca/documents/Phase1_English.FINAL.pdf)
- McCallin A., & Nayar, S. (2012). Postgraduate Research Supervision: A Critical Review of Current Practice. *Teaching in Higher Education*, 17(1), 63-74.
- Mullen, C. A. (2007). Trainers, Illusionists, Tricksters, and Escapists: Changing the Doctoral Circus. *The Educational Forum*, 71(4), 300-315.
- National Association of Graduate Admission Professionals. (2012). *Social Media Survey Report*. Retrieved from <http://www.nagap.org/documents/NAGAP2012SocialMediaSurveyReport.pdf>
- Naylor, R., Chakravarti, S., & Baik, C. (2016). Differing Motivations and Requirements in PhD Student Cohorts: A Case Study. *Issues in Educational Research*, 26(2), 351-367.
- Noel-Levitz & National Association of Graduate Admissions Professionals. (2012). *Marketing and Student Recruitment Practices for Master's-Level Graduate Programs*. Retrieved from <http://www.noellevitz.com/BenchmarkReports> and <http://www.nagap.org/Research>
- Osborne, B. J., Carpenter, S., Burnett, M., & Rolheiser, C. (2014). Preparing Graduate Students for a Changing World of Work. *Canadian Journal of Higher Education*, 44(3), i-ix.
- Pilbeam, C., Lloyd-Jones, G., & Denyer, D. (2013). Leveraging Value in Doctoral Student Networks through Social Capital. *Studies in Higher Education*, 38(10), 1472-1489.
- Rose, M. (2013). Preparing for Life "Beyond Academe": Professional Skills Development for Graduate Students in Canadian Universities. *English Studies in Canada*, 39(4), 4-8.
- Social Sciences and Humanities Research Council of Canada. (2012). *Graduate Student Professional Development: A Survey with Recommendations*. Retrieved from [http://www.sshrc-crsh.gc.ca/about-au\\_sujet/publications/SSHRC\\_Report\\_Graduate\\_Students\\_Professional\\_Skills\\_March\\_2012\\_eng.pdf](http://www.sshrc-crsh.gc.ca/about-au_sujet/publications/SSHRC_Report_Graduate_Students_Professional_Skills_March_2012_eng.pdf)
- U15 Data Exchange. 2017. Internal data.
- U15 Data. Graduate Studies. 2017. Internal data.

University of Waterloo. 2018. Graduate Student and Postdoctoral Affairs, Internal Data.

University of Waterloo. (2017). *Performance Indicators, Enrolment*. Retrieved from <https://uwaterloo.ca/performance-indicators/students/fte-enrolment>

West, I. J. Y., Gokalp, G., Pena, E. V., Fischer, L., & Gupton, J. (2011). Exploring Effective Support Practices for Doctoral Students' Degree Completion. *College Student Journal*, 45(2), 310-323.