



## **Strategic Research Plan 2012-2017**

**May 2012**

## Executive Summary

Queen's University stands unique amongst its peers. For over 170 years, Queen's has been a leader in higher education, as well as in shaping Canada's future. Queen's ranks amongst the top ten research-intensive universities in Canada, and does so as a mid-sized residential university, with a strong sense of community and purpose. At the core of its success is Queen's commitment to research excellence, and an inextricable link that binds teaching and research, with the common fundamental thread of learning.

The Queen's Strategic Research Plan (SRP) is a component of broader integrated planning and represents a subset of the overarching Academic Plan. The guiding principles that shape the priorities, investments and support for research undertaken at Queen's University reflect our academic mission as a research-intensive university with a transformative student experience.

Queen's will continue to distinguish itself as one of the most research-intensive institutions within Canada, with a continued focus on excellence, research leadership and impact at a national and international level. Queen's international reputation will be enhanced through increasing global engagement by developing and expanding international research collaborations, building sustained multinational partnerships, and understanding and addressing global challenges through international development projects.

Queen's greatest strength is the people who contribute to research and scholarly activities. Our researchers and scholars achieve national and international acclaim and recognition for their work, and we will continue to recognize and promote their research excellence and leadership. They lead in their fields and disciplines, and they lead through their ability to bring together groups across disciplines to work in interdisciplinary and collaborative initiatives. These initiatives form the basis of our Research Centres and Institutes, which reflect our University's emerging and existing strengths. Our research is enhanced by the extensive range of available infrastructure and specialized facilities. Some of these facilities form the basis of national and international platforms and others provide unique opportunities to our students, post-doctoral researchers, and visiting researchers and scholars. The University will foster the development of coordinated and collaborative management systems, along with the Faculties, to ensure the sustainability of our research infrastructure both on and off campus.

The SRP serves as a roadmap for the next five years, setting the vision for guiding and supporting research excellence, as well as for strengthening Queen's position as a top research-intensive institution, while advancing our international reputation.

Specifically, Part 1 of the Plan, *Guiding and Supporting the Research Enterprise*, sets the goals, principles and objectives of the Plan and establishes the appropriate use of metrics to measure our progress and successes, which will serve to guide us in a transparent and open manner. Finally, Part 1 outlines the support mechanisms, structures and resources needed to facilitate Queen's continued success as a research-intensive university and to advance its reputation internationally, providing twenty-one key recommendations to move us through the next five years.

*The key recommendations include the following:*

### **Measuring our Progress and Success**

1. Increase the University's ability to assess weaknesses, opportunities and strengths for establishing planning and priorities.
2. Identify key performance indicators and an appropriate set of metrics to inform decision-making and investments.
3. Develop a performance monitoring template, where research performance and successes in meeting targets will be closely tracked and develop a best-in-class tracking system.

### **Processes/Mechanisms to Advance Research**

4. Invest in, and implement, an electronic research project management system (TRAQ).
5. Ensure timely communication and effective internal processes to convey information to the research community on changes to programs, policies and guidelines.
6. Strengthen internal and external research communications, including development of a new VPR website, producing strategic publications and promoting research excellence, accomplishments and impacts.
7. Explore options for providing expert, responsive and responsible services for support of major projects and new programs.
8. Provide opportunities for students at all levels and in all academic areas to participate in research (e.g., Undergraduate student summer fellowship; Inquiry@Queen's).
9. Foster the development of coordinated and collaborative management systems to ensure the sustainability of on and off-campus research infrastructure.

### **Innovation**

10. Foster knowledge translation where the outcomes of our research can benefit society. We are committed to advancing innovation through knowledge translation, commercialization, and through the development of Innovation Park.
11. Explore evolving emphasis on Open Access and new income models for peer-reviewed scholarly publishing.

### **Collaboration and Interdisciplinary Research**

12. Undertake a full review of the policy associated with the establishment and continued operation of Research Centres and Institutes.
13. Establish an Institute for Advanced Research/Studies. The Institute will fulfill the mandate for developing a dynamic and evolving program focused on research excellence that is driven by the community of scholars and researchers drawn to the Institute responding to the most important questions and challenges.

### **Global Engagement and Internationalization**

14. Develop greater institutional coordination for global engagement and internationalization.
15. Increase global engagement by developing and expanding international research collaborations, partnerships and international development work.

## **Research Leadership and Excellence**

16. Develop and promote research leadership through achievements in excellence, CRCs, endowed and named chairs, and sponsored research chairs.
17. Review all internal research award programs and identify new ways to support programs.
18. Reinststate the Queen's National Scholar program.
19. Phase out the Queen's Research Chairs program and introduce a Research Leaders award.
20. Establish Chancellors/University Professorships in recognition of a sustained career of accomplishment in scholarly and research activities and in leadership in advancing the University's research reputation.
21. Increase the number of Research Excellence Prizes to up to five awarded each year, one in each of the five fields of health sciences, natural sciences, engineering, social sciences and humanities.

Part 2 of the Plan, the *Thematic Focus*, outlines four major research themes. Each theme contains a number of clusters reflecting emerging and core strengths demonstrated by measures such as strength of research leadership and international reputation, critical mass as evidenced through established Research Centres and Institutes, and significant investment by the University and granting agencies. The themes and their sub-clusters are as follows:

1. Exploring Human Dimensions
  - Cluster: Society, Culture and Human Behaviour
  - Cluster: Human Health and Wellness
2. Understanding and Sustaining the Environment and Energy Systems
  - Cluster: Human Aspects of Healthy Environments
  - Cluster: Ecology and the Natural Environment
  - Cluster: Energy Systems
  - Cluster: Energy and Environmental Policy
3. Creating, Discovering and Innovating
  - Cluster: Creative Production and Expression
  - Cluster: Natural and Physical Sciences
  - Cluster: Materials
  - Cluster: Advanced Technologies
4. Securing Safe and Successful Communities
  - Cluster: Democracy, Economy and Public Policy
  - Cluster: Information and Communications
  - Cluster: Infrastructure

This section of the Plan serves a number of purposes, including requirements in support of the Canada Research Chair and Canada Foundation for Innovation programs. It encapsulates our research mission, framework of planning, and our focus on research excellence. Queen's recognizes the underlying value of ongoing support of individual scholarship and also recognizes the potential of individual and team researchers from across disciplines working together to address the complex and diverse problems faced by society today.

Our focus is shaped by research clusters reflecting emerging and core strengths as demonstrated by research leadership and international reputation. We will seek to build on investments, including infrastructure, and to further develop emerging areas of strength across the spectrum of disciplines. Innovation will reflect the success of our academic programs, quality of our research and international reputation fuelled by discovery, new ideas and insights, creative works and methods, commercialization outcomes, and knowledge translation, where the outcomes of our research can benefit society broadly, whether directly or indirectly.

The Queen's Strategic Research Plan reflects the University's response and commitment to finding our balance in a shifting landscape. This document establishes a vision for the future that will guide Queen's through the next five years.

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## **Part 1:**

# ***Guiding and Supporting the Research Enterprise***



## **Part 1: Guiding and Supporting the Research Enterprise**

### **1.0 Reflections on the History of Research at Queen's**

Queen's University has a long and enviable record of achievement in scholarly work, a record founded on a focus on excellence, unbridled curiosity and creativity. Historically, Queen's has been home to some of the most distinguished scholars and contributors to Canadian society, including Dr. William Mackintosh, Professor and Head of the Economics Department and first recipient of the Royal Society Innis-Gérin medal, Dr. Arthur Lower, Professor of History and one of Canada's most eminent historians, and Dr. John Meisel whose contributions to Royal Commissions and Advisory Boards have earned him numerous teaching, research and service awards, including the Companion of the Order of Canada. This tradition continues with scholars who continue to garner national and international awards for scholarship of the highest quality.

The university's present position as the 6th most research-intensive university in Canada and the trajectory that propelled it to this point resulted from decisions taken beginning in the late 1960s. By 1991, Queen's stature as a research university resulted in it being an inaugural member of the G10, an alliance of Canada's top ten research universities, the goal of which was to increase Government support for research funding and related support. The first Steacie Prize was awarded to a Queen's researcher in 1989, and the first Killam Prize was granted the same year. Queen's has ranked first in the number of research awards and prizes per full-time faculty since 2003<sup>1</sup>.

Queen's first tentative steps toward support of innovation and commercialization research began in the 1930s, with a \$4,000 investment in the medical research of Dr. Hendry Connell, an eye, ear, nose and throat doctor, whose enzyme solution ("Ensol") for treating cataracts showed early (although subsequently unfulfilled) promise as a cancer treatment.

Now in its 26<sup>th</sup> year, PARTEQ<sup>2</sup>, Queen's arm's-length technology transfer office, manages its own Angel Network and locally funded venture fund, has returned more than \$30 million to the university and its inventors and has facilitated the creation of 44 worldwide spinoff companies that have attracted more than \$1 billion in investment.

Innovation in its broader context is exemplified across Queen's in superior academic programs, research excellence, and international reputation. Innovation is also reflected in research that brings broad benefits to society as reflected in signature knowledge translation projects including, for example, the Promoting Relationships and Eliminating Violence Network

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<sup>1</sup> 2011 *Maclean's* University Rankings

<sup>2</sup> For more information on PARTEQ, see <http://www.parteqinnovations.com/>

(PREVNet)<sup>3</sup>. This program is now an umbrella network of 58 leading Canadian research scientists and their students from 25 universities and 50 national youth-serving organizations.

Please see Appendix 1 for a detailed historical perspective on research, innovation and commercialization at Queen's.

## **2.0 Academic Planning 2010-11**

The development of the strategic research plan is a component of a broader integrated planning process and represents a subset of an overarching academic plan. Renewal of the Queen's University Strategic Research Plan (SRP) has followed the development, promulgation and subsequent approval of the 2011 Academic Plan. While separate, the review of the SRP has not been undertaken in isolation; the process has been informed by the series of visioning and planning meetings organized for the Academic Plan, beginning in 2010. Milestones in the planning process were described in *Where Next? Toward a University Academic Plan* (January 2010)<sup>4</sup> and *Imagining the Future, Towards an Academic Plan for Queen's University* (August 2010)<sup>5</sup>. The University Senate approved *The Queen's University Academic Plan 2011* in November of that year<sup>6</sup>.

*Where Next? Toward a University Academic Plan* represented the Principal's vision and ideas on the future of Queen's. This vision described a balanced academy within a research-intensive environment, innovation in all aspects of the university enterprise, interdisciplinary<sup>7</sup> curriculum and research, and a reach spanning local, regional and international connections. The Principal proposed that Queen's mission would focus on its distinctive integration of teaching and research. It follows that the breadth and depth of our research and scholarly endeavours would be commensurate with degrees offered at both the undergraduate and graduate level. Thus, the research scope of the University is defined in a bottom-up fashion, rooted in the priorities of Departments and Schools, and reflecting the work and successes of individual researchers.

In *Where Next?*, the Principal proposed that Queen's could build on the broad research expertise of the faculty to concentrate on a narrower set of cross-faculty initiatives (four or five) drawn from the top priorities of the Faculties. This vision marks a departure from the eight clusters, associated sub-clusters and themes identified in the 2006 Strategic Research Plan, and creates the

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<sup>3</sup> For more information on PREVNet, see <http://prevnet.ca/>

<sup>4</sup> <http://www.queensu.ca/principal/wherenext.html>

<sup>5</sup> <http://www.queensu.ca/awt/index.html>

<sup>6</sup> <http://www.queensu.ca/saptf/>

<sup>7</sup> The Queen's University Academic Plan 2011 p24-31 (<http://www.queensu.ca/saptf/>) provides a full discussion of disciplinarity and interdisciplinarity. Interdisciplinary/interdisciplinarity is used in the Strategic Research Planning document in the broadest sense as defined in the Academic Plan, and also embraces different academic structures (programmatic and organizational) that foster new synergies in interdisciplinary fields of research and scholarly engagement and associated graduate training.

mandate to significantly reimagine the SRP. The challenge in developing an updated SRP is to better define our priorities as a University, and also to find ways to better demonstrate the impact of our research on significant pressing and emerging national global issues.

*Imagining the Future, Towards an Academic Plan for Queen's University* lays out the challenges of striking the balance between supporting faculty-driven (bottom-up) research and teaching and the need to evolve a more strategic (top-down) approach to planning in order to take advantage of funding opportunities that are increasingly complex in structure and which have become more focused on specific (if not consistent) priorities. Taking advantage of these opportunities requires Queen's to set our own priorities, which will better define where limited resources should be allocated. Such decision-making processes will benefit from greater transparency and inclusion of the Queen's community (students, faculty, staff, alumni, and partners) through clear communication, consultation, and participation in these processes.

In *Imagining the Future*, the University defines a set of values that are relevant to the research enterprise, including quality (i.e., excellence in research), leadership, interdisciplinarity and internationalization. A series of goals are also laid out, two of which are specifically focused on research intensity. The first emphasizes fostering and sustaining a research environment that attracts the best researchers and provides an enhanced learning environment for our students.

The research mission is a defining characteristic of the University's distinctiveness, and an emphasis in the future on research intensity is proposed in all aspects of its operations, including recruitment. The second goal is focused on greater recognition of trainees, graduate students and post-doctoral fellows, their contribution to research and to advancing Queen's University. Career trajectories of these trainees are more complex and uncertain than in previous times. Partnerships, collaborative research, interdisciplinarity, global engagement and internships in non-academic settings (e.g., industry and not-for-profit organizations) are seen as essential to enhance training experiences and to increase future employment opportunities for our Highly Qualified Personnel (HQP).

*Imagining the Future, Towards an Academic Plan for Queen's University* touches upon the two opposing forces that push and pull in the development of a strategic research plan. The first aims to reflect the aspirations of the University and looks to the future, and the second captures the core competencies of the University and investments reflected in a plan required for the Canada Research Chairs (CRC) and Canada Foundation for Innovation (CFI) Programs. There is a tendency to resist change and show restraint in altering the *Strategic Research Plan*<sup>8</sup>, approved by Senate in 2003 and amended in 2006, since this potentially could negatively impact our eligibility and success in both CRC and CFI programs. At the same time, however, it is recognized that there are particular areas of the university (e.g., humanities and arts) that have

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<sup>8</sup> <http://www.queensu.ca/vpr/reportspubs/SRPjan06.pdf>

never felt that the *Strategic Research Plan* reflected their needs. There is a common sentiment amongst scholars across Canada that the value of the humanities requires greater emphasis.<sup>9</sup> The very orientation towards funding opportunities places a greater emphasis on inputs rather than outputs, and reflects areas of research and scholarly activities with larger resource requirements.

The constantly changing internal and external landscape associated with the research enterprise, nonetheless, imposes a requirement for an on-going process, driven by the Office of the Vice-Principal (Research) (OVPR), to identify core competencies, emerging areas, and opportunities for new initiatives. It is important that this occurs in a transparent manner. The shift to integrated planning will result in greater engagement of all stakeholders across the University. Importantly, this suggests a need for a multidimensional strategic research plan. *Imagining the Future, Towards an Academic Plan for Queen's University* proposes that this plan addresses, not only the strategic research priorities, but also the processes and criteria used to set strategic directions and institutional investments, as well as the ways that the University provides core support to all faculty members in their research, regardless of their research focus or relationship to priority areas.

We must measure our success and assess our progress toward set goals. Queen's values its place in the ranking of Canada's research universities (RESEARCH Infosource and U-15 benchmarks), including total sponsored research income, research intensity, research output indicators and research impact. Queen's enjoys an enviable reputation in the number of external awards and honours bestowed upon faculty (e.g., Killam, Steacie, and Trudeau awards, and fellowships in academic societies (Royal Society of Canada)). The metrics to the institution as a whole may differ from metrics for individual researchers. *Imagining the Future, Towards an Academic Plan for Queen's University* cautions that some of the measures employed to assess institutional standing must be used with considerable care (e.g., input measures (external funding)). It is recommended that wider criteria be used to assess contributions and impact and that multiple measures of research success and intensity are applied. The range and depth of information required challenges the University to better capture and manage information related to research metrics and analytics, as part of a broader initiative to inform decisions at the University.

The research-intensive University and the transformative educational experience is the centre piece of the academic vision for Queen's (*The Queen's University Academic Plan 2011*). The plan contains a number of the principles, priorities and recommendations that specifically relate to research and scholarly work at Queen's including four pillars of the academy: Student Learning Experience; Disciplinarity and Interdisciplinarity; Reaching Beyond: Globalism, Diversity and Inclusion; and Health, Wellness and Community. In particular, we can increase opportunities for undergraduates to participate in research as part of their educational experience,

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<sup>9</sup> Coleman, D. and S. Kamboureli (eds). 2011. *Retooling the Humanities: The Culture of Research in Canadian Universities*. University of Alberta Press.

promote and support interdisciplinarity, and find ways for researchers, including visiting scholars, to engage in greater reflective scholarship with each other.

Importantly, we have an opportunity to recalibrate our research orientation with an emphasis on people. The Academic Plan highlights the need for increasing recognition of the humanities and arts and the central role these areas play in research, particularly as it applies to the human experience. To address many of the world's greatest challenges, innovative ideas and technological advances brought about by discoveries in science, engineering and health will be required. We will also need the creative energy of the human spirit, and Queen's can offer an unparalleled environment to foster this.

## 2.1 Renewal of the Strategic Research Plan

Research is a core component of the mission of Queen's University and is the cornerstone for providing the best possible educational experience for students at both the undergraduate and graduate levels, for training post-doctoral fellows to become research leaders of the future, for creating a vibrant environment of inquiry, for attracting human and physical resources and for creating partnerships with our local and global communities, including industry, governments, and other institutions. At Queen's, there is an inextricable link between teaching and research; the fundamental thread is learning.

Our researchers are highly successful in attracting external grants and contracts, but our research excellence is also recognized through Queen's first place standing amongst Canadian universities in faculty research awards. Queen's is renowned for its individual scholars who have made considerable impact within their field or discipline or on society, through posing new questions, seeking to understand or explain human behaviours or finding new ways of interpreting old problems, whether in the arts, social sciences and humanities disciplines or in natural sciences, engineering and health. The high quality of our faculty, staff, students, and post-doctoral fellows supports a rich, innovative and dynamic research environment.

The origins of Queen's SRP coincided with the establishment of the CRC and CFI programs. It is a requirement of all institutions receiving funding from these agencies. While it is essential that such a plan continues to serve this purpose, it is vital to have a plan that represents our collective vision, aspirations and priorities for the future. It is a plan that also transcends research and scholarly activities of individuals.

In September 2010, the Vice-Principal (Research) (VPR) announced that renewal of the Queen's SRP would be a priority for the research portfolio, given that the SRP had last been updated in 2006 and that Queen's was developing an Academic Plan to lead Queen's into the future. A comprehensive and consultative process was developed for undertaking the SRP renewal over a 12 to 14 month timeline and this process was approved by the Senate Advisory Research Committee and subsequently, Queen's Senate. This process also included drafting a Terms of

Reference for a Research Community Committee to provide input into the plan throughout its development and included the composition of the proposed Committee. Consultation with the Faculties and broad community consultative processes were outlined, as were timelines and approvals. For the complete revision process please see Appendix 2.

Renewal of the Queen's SRP has been undertaken in parallel with the planning process for development of a new Academic Plan and regular consultation throughout the process has ensured that the SRP is integrally connected. The SRP is a result of broad internal and external consultation with Departments, Schools and Faculties, as well as industry and government. The Plan has been established to support and cultivate the research and academic environment and to provide a roadmap for maintaining and advancing Queen's position as a top ten research-intensive institution<sup>10</sup>. Growing and supporting excellence in research is at the core of the University's SRP.

Our SRP is a framework for those who have the collective vision to embrace its principles and capitalize upon the supports and structures in place to create a vibrant environment of inquiry, whether as an individual scholar or as a researcher that utilizes a collaborative and/or interdisciplinary approach to resolving the complex issues facing global citizens today. This is an institutional plan, which is informed by Faculty and Departmental/School plans. It does not replace, nor does it diminish, the value or importance of the unit plans.

Key to achieving the goals of the Plan is:

- the selection of specific strategic priority areas of research strength (existing or potential)
- continued support, and the establishment of new support mechanisms, structures and resources to facilitate Queen's success in highly competitive peer-reviewed funding programs, collaborative research opportunities, individual scholarship and in developing research partnerships with other institutions, government, private sector or non-governmental organizations
- promoting alternative operating structures, including collaborative and interdisciplinary models such as research centres and institutes, to enable researchers to respond quickly to embrace new opportunities as they arise, ensuring the research enterprise remains at the leading-edge of discovery
- supporting the recruitment and retention of highly qualified people, including top flight or up-and-coming researchers with strengths in the priority areas
- promoting knowledge-transfer opportunities for researchers to benefit the well-being of Canadians

The purpose of this SRP is, thus, to provide a roadmap for guiding and supporting research excellence at Queen's. It sets forth our vision for the next five years. The plan will be reviewed

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<sup>10</sup> See RESEARCH Infosource <http://www.researchinfosource.com/>. Research intensity is defined as total research income per full-time faculty position (full, associate and assistant faculty positions only were included).

biennially by a Research Community Committee to ensure that it is continuing to meet the needs of the Queen's research community, as well as addressing new priorities that may evolve and be supported by traditional and non-traditional sources of research funding.

### **3.0 Guiding Principles and Objectives of the Strategic Research Plan**

The guiding principles that shape the priorities, investments and support for research undertaken at Queen's University reflect our academic mission as a research-intensive university with a transformative student experience. Queen's distinguishes itself as one of the most research-intensive institutions within Canada, with a focus on excellence, leadership and impact at a national and international level.

#### **3.1 Principles**

##### *3.1.1 Research Excellence*

Queen's values and promotes research excellence in all fields of enquiry, and in individual, interdisciplinary and collaborative research. Excellence is reflected in our research reputation, research awards and prizes bestowed upon our faculty and students, impact of our research and scholarly work, and funding awards received from the three federal granting councils (Natural Sciences and Engineering Research Council of Canada (NSERC), Social Sciences and Humanities Research Council of Canada (SSHRC), and the Canadian Institutes of Health Research (CIHR)).

Funding from the granting councils is a particularly important resource in the support of students and post-doctoral researchers, regardless of area of focus. Queen's enjoys a relatively high success rate and funding rate in the NSERC Discovery Grant Program. The basic biomedical sciences account for many of our successes within CIHR but face considerable pressure in highly competitive programs, where overall success rates are considerably lower than in the NSERC programs. Similarly, social scientists and humanists encounter a highly competitive environment within SSHRC. Changes in both CIHR and SSHRC programs, and an increasingly competitive environment for NSERC funding, require the University, Faculties, Departments and Schools are working to ensure that our researchers are well equipped (program information, pre-award and mentoring support) to compete for funding from all the granting councils.

We are committed to working closely with the Faculty of Health Sciences to advance the growing clinician researcher programs at Queen's and in collaboration with the main teaching hospitals in Kingston (Kingston General Hospital, Hotel Dieu, and Providence Care).

### *3.1.2 Supporting the Academic Mission*

It is essential that research be integrated into the academic mission of Queen's. Working with the Provost and the Vice-Provost and Dean, Graduate Studies, the VPR portfolio will work to support and enhance research activities and experiential learning commensurate with high quality training opportunities for graduate students and post-doctoral researchers. The VPR portfolio will promote opportunities for increased participation of undergraduates in research, including expanding opportunities and supporting initiatives that celebrate undergraduate research.

### *3.1.3 Innovation*

Innovation is embraced in its broadest meaning where the success of our academic programs, quality of our research and international reputation are fuelled by new ideas and methods. Knowledge translation, where the outcomes of our research can benefit society broadly, whether directly or indirectly, will increasingly be an important aspect of the culture of innovation at Queen's.

We remain firmly committed to advancing innovation through support of commercialization of research at Queen's and in the region. Queen's aims to forge closer links with the City of Kingston and other centres throughout southeastern Ontario in support of regional economic development. This will include expanding and strengthening collaborative research partnerships with businesses and industries based in the region and globally<sup>11</sup>. Such relationships are particularly important and provide strategic benefits to the University, including joint funding opportunities, which provide leverage for federal and provincial government investments.<sup>12</sup> These also help us fulfill our role as a broader agent for change and innovation in our region. Increased opportunities for industry-based internships and work experience for graduate students and post-doctoral researchers will be promoted.

Opportunities to grow new businesses and industries will be based on retaining commercialization outcomes, supporting an innovation/entrepreneurial ecosystem in the region, promoting employment opportunities for graduates (undergraduates and graduates) within the region, and fostering innovation through initiatives such as Innovation Park, as well as working with not-for-profit and government organizations in support of social innovation.

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<sup>11</sup> Network of Academic Corporate Relations Officers (NACRO) Five Essential Elements of a Successful University-Corporate Relations Program, Benchmarking Committee White Paper, August 2011.

<sup>12</sup> William A. Lucas et al, "Best Practices for Industry-University Collaborations," *MIT Sloan Management Review* 51:4 (Summer 2010): 83-90.



### *3.1.4 Integration*

The VPR portfolio, working with the Associate/Vice-Deans (Research) and other members of the academic community, is committed to better coordination of efforts and to find common ground among research interests and needs across campus to enhance collaborations and greater interdisciplinary initiatives. Research centres and institutes, focused around specific areas where a combination of research resources, critical activity and opportunity, and collaborations exist, will reflect the maturation and excellence of evolving collaborative efforts in important and emerging research areas for the University.

### *3.1.5 Integrated Planning*

The principles of integrated planning will guide the Queen's research enterprise. Recognizing the complexities of research, the continued evolution of the research enterprise will be gauged against the University's investments in research, the ability to financially and administratively<sup>13</sup> support the research undertaken, the physical resources required, and the plans to sustain the research program or infrastructure developed.

### *3.1.6 Compliance and Accountability*

Queen's is committed to fully meeting compliance and accountability obligations arising from research funding opportunities and recognizes that failure to do so may result in termination or suspension of funding and significant reputational harm. To effectively meet these growing obligations, adequate resources will be required across the University, including the VPR portfolio, which directs about 80% of its resources to these activities, Financial Services, Strategic Procurement Services, Physical Plant Services, Environmental Health and Safety, Information Technology Services, Faculties, and Departments.

### *3.1.7 Communication*

Queen's is committed to ensuring open and transparent communication of research support strategies and other research issues through advisory bodies such as the Associate/Vice-Deans (Research); it is committed to communication of research excellence, impact and advancing the engagement of our partners.

## 3.2 Objectives

The objectives of this SRP are as follows:

1. Foster and enhance internationally recognized research programs and emerging research strengths. Queen's international reputation will be augmented through increasing global

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<sup>13</sup> Includes Physical Plant Services (PPS)

engagement by developing and expanding international research collaborations, such as the Matariki Network, building sustained multinational partnerships, and understanding and addressing global challenges through international development projects.

2. Promote and enhance our research and scholarly activities that provide transformative experiences for undergraduates, graduate students and post-doctoral trainees.
3. Promote and enhance opportunities for collaborative and interdisciplinary initiatives between faculty across the University and with other universities and institutions.
4. Promote and enhance research partnerships that expand on our research strengths, increase the support for research, and enhance the delivery of research to stakeholders and partners locally, regionally, nationally and globally.
5. Advance diversity and inclusivity through research that leads to increased understanding of cultures and communities within Canada and abroad, and research that enables connections to people and the quality of their lives.
6. Encourage and support the translation and transfer of research outcomes, new knowledge and innovation for the betterment of society. New models for dissemination and accessible information will be developed and applied. We will enhance the ability to transfer research knowledge to a wider community of knowledge users and policy makers.

## **4.0 Current Context**

### **4.1 Research Rankings**

Total annual research funding at Queen's has increased from \$83.2 million in 1999/00 to \$163.3 million in 2010/11. According to the RESEARCH Infosource 2011<sup>14</sup> survey of Canada's Top 50 Research Universities (based on 2009/10 data), Queen's remained 11<sup>th</sup> overall in sponsored research, 6<sup>th</sup> in research intensity, with dollars per FTE at \$237,900, up from 7<sup>th</sup> in the previous year.

In drilling down Queen's 11<sup>th</sup> place ranking in sponsored research income, Queen's total research income of \$197,016,000 was generated with a faculty (full, associate, assistant) complement of 828. In comparison, the tenth ranked University of Western Ontario raised \$221,236,000 in sponsored research income, with a faculty size of 1,422. The 12<sup>th</sup> ranked University of Saskatchewan, and the 13<sup>th</sup> ranked University of Manitoba earned research income of \$184,756,000 and \$164,695,000, with respective faculty counts of 1131 and 1197. The top ranked University of Toronto had research income of \$878,725,000 with a faculty complement of 2,439.

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<sup>14</sup> For more detailed information on Canada's Top 50 Research Universities, see <http://researchinfosource.com/>

According to the 2011 Maclean's University rankings, Queen's continues to top all universities in terms of national research awards per full-time faculty, holding the #1 ranking since 2003; we ranked 9<sup>th</sup> in Social Sciences and Humanities Grants (up from 10<sup>th</sup> in 2010 rankings), 4<sup>th</sup> in Medical/Science grants (Queen's has maintained 4<sup>th</sup> position since 2009) and 7<sup>th</sup> in total research dollars.

#### 4.2 Other Research Related Facts<sup>15</sup>

In November 2011, the U15 Data Exchange shared data (2009-2010) on the following research facts: Ph.D.s granted, number of Post-Doctoral Fellows, number of Research Associates/Assistants, library holdings, license income received, spin-off companies created and U.S. patents granted.

- Queen's granted 147 Ph.D.s in calendar year 2009, placing 12<sup>th</sup> out of 13
- Queen's reported 172 Post-Doctoral Fellows, placing 11<sup>th</sup>
- Queen's reported 35 Research Associates/Assistants, ranking 11<sup>th</sup>
- Queen's library holdings (total equivalent volumes) were 6,636,183, ranking it at 5<sup>th</sup>
- Queen's reported \$5,756,789 in license income received between 2006/07 to 2008/09 based on a 3 year total, ranking 5<sup>th</sup>
- Queen's reported 1 spin off company created, ranking 10<sup>th</sup> (tied with 2 others)
- Queen's reported 28 U.S. patents granted between 2006/07 to 2008/09, placing 4<sup>th</sup>

### **5.0 Metrics: Measuring Our Success**

Establishing metrics to assess our progress and success is crucial to the roadmap guiding and supporting research excellence. We do not have an institutional framework for capturing information and analysing our strengths, weaknesses and opportunities in a timely manner. The evaluation of research performance and excellence is a critical feature for setting priorities. There is no single measure of research performance, and promotion and tenure committees use a variety of metrics formally and informally. Research funding, quality and impact of peer-reviewed publications, prizes, awards, fellowships, conference proceedings, membership in significant national and international groups, and favourable reviews of exhibitions, books, art, and plays are examples of such metrics. Moreover, there is increasing reliance on metrics from government and the public for increased accountability and transparency. The breadth and depth of information required for new and emerging metrics, including partnerships, career trajectories of our graduate students, industry participation, innovation, knowledge translation and commercialization, requires that the university collect and analyze data on research performance related to these areas. Importantly, we need to emphasize those metrics associated with

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<sup>15</sup> Presidents' Fact Book 2009-2010 Prepared for G13 Data Exchange

innovation that reflect the excellence of our academic programs that support research, the quality of our research, and our international reputation.<sup>16</sup>

### 5.1 Evaluating Research Strengths and Setting Priorities

Key areas for evaluating the core strengths of research programs include:

- Discipline, Field, Faculty Specific
- Bibliometric
- Economic and Social
- Knowledge Translation/Transfer, Commercialization and Innovation
- Local, Regional, National and Global
- Collaborative and Interdisciplinary Research

For each of these, a number of specific indicators to measure success have been identified (see Appendix 3) but these are selected examples only; there are many other measures available that will need to be utilized to ensure we are successfully measuring and monitoring research performance and excellence. More importantly, key performance indicators are to be identified and an appropriate set of metrics used to inform our decision-making and investments.

Fundamentally, the various indicators can be aggregated to reflect three criteria in the evaluation of institutional research strength: productivity, institutional commitment, and integration. Evidence of consistent and successful, high level productivity includes *training of HQP*, *dissemination of research*, and the *ability to sustain productivity*. Institutional commitment and integration serve as signals of research strength. Research strengths could be expected to arise where there is critical mass (including recruitment strategies), clear Departmental and Faculty champions, strong graduate programs or where there is potential for new programs to emerge, infrastructure is available or attainable, collaborations and interdisciplinary activity, and contributes to Faculty and institutional priorities as reflected in the SRP.

To ensure that we effectively measure our research progress and successes, we will seek to:

- Consult broadly to ensure that we have identified the most representative qualitative and quantitative measures of success for all disciplines, particularly those within the arts, social sciences and humanities, where indicators of success within individual disciplines may be specific.

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<sup>16</sup> OECD (2011) Science, Technology and Industry Scoreboard 2011, Innovation and Growth in Knowledge Economies, OECD Publishing. [http://dx.doi.org/10.1787/sti\\_scoreboard-2011-en](http://dx.doi.org/10.1787/sti_scoreboard-2011-en)

- Develop a performance monitoring template, where research performance and successes in meeting targets will be closely tracked. In addition to developing a template, we will work with Institutional Research and Planning to develop a best-in-class annual tracking system. It will be essential that appropriate research information management tools be implemented to support appropriate research planning strategies, including performance assessment.
- Ensure that we retain the ability to recognize new evolving research programs that have a high potential for growth and success based on accomplishments of faculty or recruitment strategies that develop, or are developing, collaborations and interdisciplinary initiatives, evolving unique models or expertise to address either problems that have not yet been addressed or potential new emerging issues of great need and importance.

## **6.0 Processes/Mechanisms to Advance Research at Queen's**

Over the past two decades, Queen's has built upon its research strengths, building and enhancing world-class research facilities, attracting and retaining both the bright stars of tomorrow, as well as the highly experienced, world-renowned researchers of today, which in turn helps us attract top undergraduate and graduate students, as well as highly trained post-doctoral fellows.

Queen's has a number of internal programs that support research, including: provision of start-up research funding for faculty, assistance in finding funding opportunities through existing and new funding mechanisms, internal award programs that support research, conference and travel funding and mechanisms to promote and showcase researcher successes. Additionally, the University's model for distribution of the indirect costs of research flows funding to Department and Faculty budgets, as well as supporting central and other support services, such as the Office of Research Services (ORS), Library, IT and Physical Plant Services, all of which provide key internal support for our researchers, and, importantly, our students.

With its commitment to remaining a mid-size university, Queen's will never achieve the size and scale associated with a number of other Canadian campuses. It is thus necessary to focus available resources in such a way that they provide maximum benefit. To build areas of research strength, significant financial support is often needed in the form of matching funds for infrastructure, initiation grants, funding for new initiatives, administrative support and funding for students and post-doctoral fellows. Although some of these needs can, and should be, funded from external sources, some cannot, and as initiatives are developing or during gaps of external funding, internal support is often necessary.

Indirect costs of research are a key funding source for research initiatives. Our Library and information technologies are supported, in part, by these funds. Maintaining and increasing our research funding from the Granting Councils, as well as from other indirect cost generating

sources, such as industry contracts will be key in maintaining these critical funds to support both current research and identified foci. In the difficult economic times that all universities are facing, it will be critical to be creative and focused in identifying new ways to support research, as well as re-examining the current mechanisms for supporting research.

## 6.1 Vice-Principal (Research) Portfolio

The VPR portfolio currently consists of the OVPR, the ORS, the eQUIP Taskforce (eQUIP), the Office of the University Veterinarian (OUV), Innovation Park at Queen's University, and Industry Partnerships. The OVPR is also responsible for the oversight of PARTEQ, the arm's-length technology commercialization office of the University, and provides oversight in terms of the Senate mandated five-year review processes for University-based Research Centres and Institutes.

### 6.1.1 *VPR Portfolio Vision*

The VPR portfolio is committed to the following:

To become the foremost university research portfolio in Canada by:

- having highly engaged employees;
- delivering significant value to the Queen's research community; and
- influencing the provincial, national and international research agenda

### 6.1.2 *VPR Portfolio Mission/Mandate*

*To stimulate, enhance and facilitate ethical research and scholarship at Queen's by providing leadership, support and services to advance Queen's position as a research-intensive university, while raising awareness of the excellence of Queen's research and providing accountability to our stakeholders.*

In short, our goal is:

*"Helping people achieve excellence in research and scholarship"*

### 6.1.3 *Support to the University*

The University community (including those conducting research at the three affiliated teaching hospitals) draws upon various critical services provided by the VPR portfolio, which include: communication of funding opportunities; proposal development and application review prior to submission to external funding agencies/sources; negotiation of sponsored research and collaborative research agreements and contracts (including legal review); promoting researchers through national and international research award nominations, researcher recognition events and

other communication opportunities; providing guidance and support to Research Centres and Institutes; certifications associated with compliance requirements (ethics, animal care and biohazards); post-award changes, monitoring and reporting; and the development of research partnerships.

The VPR portfolio offers ongoing post-award activities, including workshops, interactions with Finance, Procurement, Physical Plant Services and Environmental Health and Safety, as well as meetings with individual project leaders which ensure greater awareness of sound and effective financial management procedures.

Working with Internal Audit, the VPR provides yearly feedback on the research enterprise, flagging potential concerns<sup>17</sup> or soliciting support in keeping issues impacting research moving forward through the appropriate administrative channels. Areas that are reflected upon include administrative concerns, the internal control environment, IT system changes, organizational change, new legal regulations and/or contractual changes.

Queen's, as with all universities, is also subject to ongoing audits by the Tri-Council, CFI and Ministry of Economic Development and Innovation (MEDI – formerly MRI). These regular audits keep Queen's on track for developing and implementing excellent systems of pre and post-award management of research awards.

These activities require sufficient administrative support and resources. The current organizational and operational structures are no longer sustainable within the present budget model. While significant changes have been made to address the structural deficit of the portfolio, further changes are necessary, while retaining the ability to provide best-in-class service and support. An adequate level of resources is required to provide these services and support, but these and new investments in support of the research enterprise (e.g., international and communications) must also be provided from the funding being sought either directly, or through indirect costs and overhead.

#### *6.1.4 Tools for Research Administration at Queen's (TRAQ)*

Critical to achieving a successful research program, research administrators and researchers must have access to appropriate administrative tools. Queen's research activity comprises 4,700 individual projects that are managed by 1,300 individual researchers and their staff. These figures do not include other users, for example, finance and research services staff, and Department and Faculty office representatives, bringing the total number of users to upwards of 3,000 individuals.

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<sup>17</sup> For example: changes in funding programs, compliance and reporting

The complexity of compliance requirements is increasing (e.g., reporting of research costs and outcomes of research). Queen's researchers collaborate with approximately 450 research funding programs and research sponsors combined in any given year. It is essential that Queen's University has a robust electronic research system to manage these 4,700 research projects and the millions of associated dollars. A system is critically needed to:

- capture data on research awards, contracts, and clinical trials;
- manage daily workflow;
- manage certifications (i.e., human ethics, environmental health and safety, and animal care); and
- provide efficient customer service

Changing regulations and economics in higher learning institutions have put increasing pressure on universities to produce accurate and detailed reporting. Without an electronic research project management system, reporting is very labour intensive, and there is risk associated with human error and non-compliance with funders' policies.

#### *6.1.5 Education and Professional Training*

It is incumbent upon the University to ensure that faculty and staff are knowledgeable of the range of services and supports available for their research programs and scholarly pursuits (e.g., funding opportunities; on-line tools). Importantly, they are expected to be knowledgeable of internal and external policies and guidelines associated with awards including eligible expenses. The VPR portfolio is committed to effective communication strategies to inform the research community of policies and guidelines and changes to these in a timely manner. Training programs and workshops will be provided for new employees, as well as refresher courses on research funds and programs. Opportunities to work with Human Resources and with Open Learning to develop and deliver education, training, and professional development to meet the requirements for new faculty and administrative staff at the Departmental/School and Faculty level will be explored.

#### *6.1.6 Internal and External Communications*

Research Communications plays an important role in promoting our research programs and research success, both internally and externally. Greater emphasis will be given to digital content, development and maintenance of the VPR website, and implementation of internal and external communication strategies. Promoting research success will be dependent upon the excellent linkages and coordination, and enhanced efforts to maintain these, between the OVPR and Marketing and Communications. We are committed to reintroducing an annual report of our activities and successes, to producing strategic publications for the purposes of promoting and advancing research strengths, to promoting researchers and their accomplishments through



researcher recognition events and to strengthening our communications with internal, as well as external stakeholders by advancing renewal of the VPR website.

#### *6.1.7 Research Support Systems*

The VPR portfolio is committed to providing services to support researchers in realizing their research goals. The supports offered will continue to reflect the needs of our faculty and evolve with changes in external funding opportunities, compliance requirements and available resources. In recent years, we have seen an increased need for expert and intensive support for major projects and new programs. We will continue to explore options for providing expert, responsive and responsible services. Greater involvement of Faculties and Departments, particularly at the research program initiation and funding application stages, will be explored, with the ultimate goals of enhancing research activity and increasing participation and success rates in external funding programs.

#### *6.1.8 Enhancing Research: Undergraduate, Graduate, Post-Doctoral and Staff Contributions*

Queen's is dedicated to providing opportunities for students at all levels and in all academic areas to participate in research regardless of discipline. The University remains committed to fostering opportunities for undergraduate research experiences, such as the undergraduate student summer fellowship program<sup>18</sup> launched in 2011, as well as through programs such as Inquiry@Queen's<sup>19</sup>. Queen's recognizes the value of integrating research opportunities within the undergraduate experience and have developed founding principles<sup>20</sup> for an excellent undergraduate research experience. They are as follows:

- Undergraduate students are capable of contributing meaningfully to scholarly research.
- The undergraduate student experience is profoundly enhanced and shaped by access to research opportunities.
- Inquiry should be infused within all levels of undergraduate academic programs.
- Research from all fields of study, particularly the humanities, arts, and social sciences, must be valued and adequately supported.
- Appropriate financial, personnel, and information resources should be allocated towards providing enhanced undergraduate research opportunities.
- Metrics should be established to assess the availability of research opportunities and the quality of the undergraduate research experience.

We will endeavour to seek opportunities to increase the participation of undergraduates from all disciplines to participate in research and will work with the AMS, Faculties and other

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<sup>18</sup> For more information, see <http://www.queensu.ca/ors/USSRP.html>

<sup>19</sup> For more information on Inquiry@Queen's, see <http://www.iatq.ca/>

<sup>20</sup> AMS contribution to SRP process

stakeholders to discuss recommendations to enhance undergraduate research experiences. These include:

1. Thinking Locally and Beyond the Sciences
2. Online Hub of Undergraduate Research Resources and Opportunities
3. Promoting Funding Opportunities to Students
4. Supporting and Enhancing Undergraduate Student Research through Queen's Libraries
5. Recognizing Excellent Research Mentors

Graduate students and post-doctoral fellows are essential contributors to quality research and teaching at Queen's. We compete both nationally and internationally for qualified graduates and post-doctoral fellows, thus we must be able to provide top facilities for conducting research, we must be able to attract and retain stellar faculty who will in turn attract both the best and brightest students and post-doctoral fellows.

Queen's supports graduate students through supporting faculty in the development of their research programs, by facilitating successful research funding opportunities and through external recognition, such as national and international awards. Queen's also supports initiatives that bring excellent graduate students through interdisciplinary programs, such as those offered through the Centre for Neuroscience Studies<sup>21</sup> (CNS) and the Human Mobility Research Centre<sup>22</sup> (HMRC), as well as collaborative graduate programs, such as the GeoEngineering Centre<sup>23</sup> at Queen's-RMC (GeoEng), which attracts a large number of excellent HQP each year.

It continues to be increasingly important to capitalize on programs such as NSERC Collaborative Research and Training Experience (CREATE) and CIHR programs to leverage our research strengths to enhance partnerships with other institutions and industry and integrate training of HQP.

Additionally, we encourage pursuit of opportunities through the Federal Economic Development Agency for Southern Ontario (FedDev Ontario) and the Mitacs Globalink (international undergraduates coming to Canada for summer research projects) program by partnering with relevant Faculties to promote student research experiences with industry, small and medium enterprises and expose prospective trainees to Queen's.

Post-doctoral fellows contribute significantly to the successful research and subsequent publication records of their faculty mentors and are integral to research-intensive institutions. Currently, however, there is no explicit role for post-doctoral fellows at Queen's, thus we need to develop a clear definition of the role of post-doctoral fellows and how they are integrated within the research community.

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<sup>21</sup> For more information, see <http://www.queensu.ca/neuroscience/index.html>

<sup>22</sup> For more information, see <http://me.queensu.ca/HMRC/index2.html>

<sup>23</sup> For more information, see <http://www.geoeng.ca/>

Queen's staff not only play a significant role in the success achieved by the researchers for<sup>24</sup> whom they work, they are also critical for enhancing and advancing the research environment on campus. The staff at Queen's is renowned for its dedication and expertise in supporting the research community.

## **7.0 Research Infrastructure, Libraries and Technology**

State-of-the-art research facilities are a key ingredient for delivery of high quality research and training programs in support of the University's strategic research priorities. The Isabel Bader Centre for the Performing Arts, opening in 2013, will be a world-class facility where community, student performance, education, creativity and training blend to facilitate and encourage interdisciplinary and collaborative opportunities for the arts at Queen's. The School of Music, Department of Drama, Department of Film and Media and the Department of Art will share the exhibition, performance and teaching spaces within the Centre, and embrace the principle of interactivity and integration through common teaching rooms, joint courses, and shared public spaces and services.

These research facilities play a key role in attracting excellent researchers and students. The investment through the CFI, since 1997, has contributed significantly to the range of excellent facilities and equipment such as the Magnetic Resonance Imaging facility within the Centre for Neuroscience Studies. The Queen's University Biological Station<sup>25</sup> (QUBS) has grown over a sixty-year period through land purchases and gifts to include over 3000 hectares of land located 50 kilometres north of Kingston. Queen's is at the forefront of supporting and leading major science platforms, along with collaborating universities, including SNOLAB<sup>26</sup> and the High Performance Computing Virtual Laboratory<sup>27</sup> (HPCVL). These have also received significant CFI investments and represent significant research assets to be leveraged and supported in a more sustainable way. Developments at Innovation Park are providing another dimension to our research infrastructure and capacity.

Greater coordination and engagement of all stakeholders in planning and governance in support of our research infrastructure is required. These facilities take many forms, including experimental laboratories, and occupy a range of space within the core campus or at satellite locations (within and outside of Kingston). The requirements to initiate, sustain and enhance these facilities are often unique. The infrastructure must be of the highest calibre at the time it is acquired/established, its operation must be adequately resourced, including regular and on-going preventative maintenance, repair and upgrading, as well as staffed by well-trained and expert operators to ensure its functionality remains effective and cost-efficient over the full life-span of

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<sup>24</sup> For more information, see <http://www.queensu.ca/badercentre/>

<sup>25</sup> For more information, see <http://www.queensu.ca/qubs/index.html>

<sup>26</sup> For more information, see <http://www.snolab.ca/>

<sup>27</sup> For more information, see <http://www.hpcvl.org/>

the facilities and equipment. It is critical that infrastructure, particularly with regard to new research initiatives and/or new faculty, is established in a timely and efficient manner. Appropriate mechanisms must also be in place to support sun-setting and decommissioning of facilities when these are no longer required or can no longer be supported.

The OVPR, along with the Provost and the Vice-Principal (Finance and Administration), will foster the development of coordinated and collaborative management systems, along with the Faculties, to ensure the sustainability of our research infrastructure on and off campus.

### 7.1 Libraries and Technology

Libraries and information technologies represent a key component of research infrastructure, essential for facilitating the creation, preservation and dissemination of knowledge. Since its inception, Queen's has seen the wisdom of investing in its libraries and researchers have collaborated with librarians to develop excellent research collections, services and facilities. In recent years, the internet and other advances in technology have provided unparalleled opportunities for expanding the availability of research, and libraries have worked collaboratively to leverage those opportunities. The Queen's Library collections have vastly expanded with the digital environment and the CFI-supported Canadian Research Knowledge Network and other consortia. Now, and moving forward, facilitating access to knowledge encompasses more than scholarly publications; it relates to a range of needs and opportunities for e-research.

E-research encompasses all digital research creation and output. Specifically, it comprises data production and curation, computational science, high speed networks, high performance computing and storage, social networking, publishing and the use of physical spaces for social interaction.<sup>28</sup> Queen's researchers must be able to participate fully in the emerging e-research paradigm which enhances discovery, excites interdisciplinary exploration and deepens research impact world-wide.

Working together and in collaboration with regional and national groups, the Library and IT Services envision a seamless distributed infrastructure of services for the deposit and repurposing of data. There is a strong foundation on which to build these initiatives. As a participant in the Ontario Scholars Portal, Queen's is already part of an advanced data infrastructure. Scholars Portal stores and provides access to over 11 million journal articles, has developed a robust numeric data infrastructure and a geospatial portal, and is developing new research data infrastructure as a member of the International Polar Year Data Assembly Centre Network. Scholars Portal is in the final steps towards ISO certified Trusted Digital Repository status. Locally, Queen's has substantial experience, such as the HPCVL, a Statistics Canada Research

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<sup>28</sup> ARL/DLF E-Science Institute, <http://www.arl.org/rtl/eresearch/escien/escieninstitute/index.shtml>

Data Centre and a strong social sciences data service in the Library where staff perform data mark-up, storage and retrieval. As well, Queen's has the advantage of a network of liaison librarians deeply embedded in Faculties who can help bridge the researcher to their discipline resources and help with connections across the research spectrum. In recent years, there has been growing activity and interest amongst researchers in the storage, mark-up and retrieval of research data. We also have outstanding physical libraries that already provide vibrant community space and could be further enhanced as collaborative research space.

Access to scholarly publications will be no less important, but it will not be limited to those purchased from publishers and will include research output made available in Open Access models. Such models provide rapid, free access over the internet to works that scholars have traditionally produced without expectation of payment. Many academic institutions are supporting Open Access by building digital repositories to distribute faculty scholarly articles and other research outputs that are also peer-reviewed and published. At Queen's, the QSpace repository delivers theses, articles and special collections to scholars world-wide, and the Open Journal System service provides a platform for publishing online journals. As a member of the Scholarly Publishing and Academic Resources Coalition, Queen's supports the principles of Open Access and the exploration of new income models for peer-reviewed scholarly publishing.<sup>29</sup> With many governments adopting policies to make publicly funded research freely available, Open Access has grown beyond a movement to an emerging imperative, and no doubt will increasingly shape the way in which research will be undertaken in the future.

## **8.0 Collaboration, Interdisciplinary and Cross-Faculty Initiatives**

The SRP upholds the commitment to the breadth and depth of the research enterprise, consistent with the academic plan and informs learning and teaching at the graduate and undergraduate levels. It is within the Faculty and Department led research plans where the breadth and depth is articulated, and where the focus is on individuals and department-led research initiatives.

We recognize the underlying value of academic freedom and uphold that value, through our ongoing support of individual scholarship within disciplines and by recognizing the important contributions that continue to be made through this approach to research. Facilitating collaborative, synergistic research, however, is a focal goal of this SRP, as is interdisciplinarity: increasingly, both individual and team researchers from across disciplines are working together to solve the complex and diverse problems faced by society today. Interdisciplinarity increasingly fuels both individual and team authored research production, while collaboration, both disciplinary and interdisciplinary, is sustained by a diverse and fertile range of methodological strategies and institutional structures for knowledge and resource sharing and

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<sup>29</sup> *Income models for Open Access: An overview of current practice*, <http://www.arl.org/sparc/publications/papers/imguide.shtml>

dialogue among multiple researchers in the development of innovative research programs, whose results may be organized and presented by individuals or by teams.

Queen's researchers have historically been engaged in a wide variety of collaborative research projects and many of these collaborations have resulted in the development of Queen's signature Research Centres and Institutes, which are formally established within the policies set by Queen's Senate. Research Centres and Institutes exist within all Faculties, within the Schools (currently Business and Law) and may also be University-based, which include those that are multi-disciplinary, crossing several Faculties, or even multi-institutional. Research Centres and Institutes are one of the important indicators of research strengths and interdisciplinary collaborative endeavours. A full review of the Senate policy will be undertaken to ensure that these remain relevant to this expectation of our Centres and Institutes.

Two of our Centres (CNS and the GeoEng), and one of our Institutes, the Cancer Research Institute (CRI)<sup>30</sup> offer interdisciplinary collaborative graduate programs, and others, including Queen's Institute for Energy and Environmental Policy<sup>31</sup> (QIEEP), Queen's-Royal Military College Fuel Cell Research Centre<sup>32</sup> (FCRC), and HMRC support interdisciplinary models of research.

For interdisciplinary, cross-cutting strategic foci to succeed, we must reach beyond current Department/School and Faculty structures. We are committed to promoting and fostering greater interactions across the University and between visiting scholars and researchers with our students and researchers. For our interdisciplinary initiatives to truly flourish, and reflect the level of excellence that defines our international reputation, we must also be a destination for the world's leading researchers and scholars. We must create places on our campus where the most important questions and ideas are discussed, challenged and studied in a dynamic way.

### 8.1 Institute for Advanced Research/Studies

The creation of an Institute for Advanced Research/Studies represents a particularly important opportunity for Queen's. Worldwide, institutes of advanced research/studies have been created to nurture research and intellectual engagement at the highest levels<sup>33</sup>. Some are characterized by the community of scholars drawn to the institute and have no formal affiliation with a particular school (e.g., Princeton), and others are oriented towards interdisciplinary research in advanced areas of institutional strength (e.g., Stanford). Regardless, each serves as a beacon for research excellence, building an international reputation, providing a window and door to the world, and

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<sup>30</sup> For more information, see <http://qcri.queensu.ca/>

<sup>31</sup> For more information, see <http://www.queensu.ca/qieep/>

<sup>32</sup> For more information, see <http://www.frc.ca/>

<sup>33</sup> Examples of institutes include those at University of Stellenbosch ([www.sun.ac.za](http://www.sun.ac.za)), University of Durham ([www.dur.ac.uk](http://www.dur.ac.uk)), University of British Columbia ([www.ubc.ca](http://www.ubc.ca)), Technical University of Munich ([www.tum.de](http://www.tum.de)), Princeton University (<http://www.ias.edu>), and Stanford University (<http://hstar.stanford.edu>)

establishing their respective institutions as a destination for the world's best researchers and scholars.

Development of a new Institute for Advanced Research/Studies at Queen's will provide a focus for dialogue amongst the research community. The Institute will fulfill the mandate for developing a dynamic and evolving program focused on research excellence that is driven by the community of scholars and researchers drawn to the Institute responding to the most important questions and challenges.

## **9.0 Advancing International Research Priorities and Global Partnerships**

Increasingly, research-intensive universities are paying much greater attention to a global focus, whether through development of international campuses, student exchanges, international work and study opportunities, dual degree programs or increasing focus and investment in international research and international development opportunities. It is our intent to foster and enhance internationally recognized research programs and emerging research strengths. We propose that Queen's international reputation be augmented through increasing global engagement by developing and expanding international research collaborations, building sustained multinational partnerships, and understanding and addressing global challenges through international development projects.

Many of our faculty have significant international engagement through formal, as well as informal, research collaborations, MOUs and participation in international initiatives. Most of these international activities are pursued by the investigators themselves, with support coming from the University, in terms of the application process and the provision of ongoing communication with regards to the various funding opportunities that are available.

Several of our Research Centres and Institutes are world-renowned in the research they undertake nationally and internationally. Some examples include:

- The Centre for Energy and Power Electronics Research (ePOWER) brings together academic and industrial researchers to develop a broad range of applications and expertise, from power transmission to alternative energy, to power consumption, to power application-specific integrated circuits. ePOWER collaborates with researchers in the UK, India and Australia.
- The Clinical Trials Group carries out clinical trials in cancer therapy, supportive care and prevention across Canada and internationally. Investigators in the Division of Cancer Biology and Genetics are involved in formal collaborations with investigators in the US, the UK, France and Sweden and individual investigators in the Division of Cancer Care and Epidemiology are involved in several international initiatives and research

collaborations with other investigators from Italy, Turkey, Poland, Spain, Portugal, England, the Netherlands, Germany, the US and Australia.

- The Fuel Cell Research Centre is founded on the principles of interdisciplinarity and is advancing the knowledge base for addressing the key technology challenges to the commercialisation of fuel cell applications. They regularly host international delegations and have active collaborations in Norway, the UK, Germany, the US, Brazil, Chile, India, South Africa, Denmark, Italy and several others
- The GeoEngineering Centre has been actively engaged in setting international engineering practice and policy in their areas of research focus, including Canada, the US, Europe, Australia, and South Africa. It has active collaborative research with universities in Australia, Italy, India, Japan, Norway, Switzerland, Turkey, the UK and the US.
- SNOLAB, an international facility for astroparticle physics research, is a research institute at Queen's with a Trust Agreement with its partner institutions (Carleton University, Laurentian University, Université de Montréal and University of Alberta). Typical experiments at SNOLAB have 50 to hundreds of collaborators. These collaborators are from Canada, the US, the UK, France, Germany, Portugal, the Czech Republic and India.
- The Southern African Research Centre (SARC) is a focal point within Canada for research and international development programmes focused on the SADC region. The overall aim of SARC is to contribute to regional cooperation and development in Southern Africa through basic research, training and capacity building, the delivery of Canadian expertise and policy inputs; and the planning and development of academic and applied research and development projects.
- The Surveillance Studies Centre is a unique multi-disciplinary and international research initiative that examines social, technical, political, geographical, psychological, ethical, economic and military dimensions of surveillance. It enjoys extensive international collaborations with individuals worldwide and with surveillance studies groups in Japan, Italy, Germany and Latin America. Visiting scholars and students have come from Italy, Japan, Scotland, Sweden and the US.

To a certain extent, international research and international development has been supported by the VPR portfolio for many years, largely in the application process or by providing information on funding opportunities. It is apparent that an integrated strategic and proactive approach is required for the University, while recognizing that international research and international development collaborations are typically holistic and developed from the bottom-up. We do not necessarily have to look too far to recognize the opportunities to build upon existing platforms (i.e., Bader International Study Centre, Herstmonceux, East Sussex, UK, and Fudan University, Shanghai, China, Matariki Network) to enhance our global reach.



Over the coming months, the VPR and the Provost will be working together to address the organizational structures and operational requirements to best serve our institutional strategy for global engagement and internationalization.

## **10.0 Research Leadership and Excellence**

### **10.1 Cultivating leadership**

Research success and scholarly achievement requires committed and continuous leadership. The CRC, sponsored chairs and endowed/named chairs programs provide recognition and support for research leadership in various areas within the university. There are of course academic administrators (including Heads and Deans as well as members of the senior executive) who provide an important level of leadership in their respective roles. For the purposes of advancing institutional strengths and priorities, the research leadership required is more complex. The attributes of well-led Research Centres and Institutes probably best reflect the following key principles for effective leadership.

Key principles for leadership:

- research priority areas will only be successful if there is strong leadership in the area
- leadership may be provided by a single individual or by a team of leaders
- leadership capabilities include excellence in research, excellence in motivating, organizing and inspiring research teams, creating and maintaining research partnerships and collaborations, and working with major research funding agencies
- developing research leadership capabilities should be a priority
- succession planning is critical to ensuring continued long-term leadership in key research areas

We will also look to our research chairs for leadership beyond their individual programs, with an overarching need to provide broader leadership within Queen's, and externally, in their research field and in strengthening the research of others. The quality of our research leaders is vital to the effectiveness of our research program, particularly in strategic research priorities. Queen's has been fortunate to have benefitted from the leadership of many outstanding researchers. We must, however, invest in a deliberate process to identify research leaders to serve as role models to early and mid-career researchers and/or where potential research leaders are systematically identified early in their careers, are mentored and supported to develop their potential. Nurturing future research leaders early on will create a talent pool for the future, ensuring competitive advantage through future years.

## 10.2 Supporting and Recognizing Leadership and Excellence

As indicated above, research leadership begins with the efforts and accomplishments of individual researchers in all areas of endeavour. The OVPR remains committed to supporting the coordination of nominations and applications in advancing outstanding researchers through nominations for awards, recognition and fellowships offered by leading scholarly and research organizations.

Queen's supports programs and opportunities to recognize the leadership and excellence of our faculty, including CRCs, sponsored chairs (industry/NSERC) and endowed/named chairs. We remain committed to these and to the development of a greater number of sponsored, endowed and named chairs. The OVPR will work closely with the Faculties, the Provost and the Office of the Vice-Principal (Advancement), particularly with respect to endowed and named chairs in support of key research priorities for the University.

Queen's has a long history of internal support for research leadership and excellence. These have included the Queen's National Scholar (QNS) program, Queen's Research Chairs (QRC), and Research Excellence Prizes. While some of these programs have been suspended (QNS) or face elimination (QRC) owing to budgetary constraints and shifting priorities, it is clear that the University must develop mechanisms to cultivate and recognize research success and leadership in a systematic and sustainable manner.

To ensure that we provide support and growth opportunities to develop research leadership at Queen's, we will seek to:

- review all internal research award programs and identify new ways to support programs, as well as ensure that programs are relevant to the research community
- work with early, mid-career and senior researchers to help promote their research careers
- collaborate with and support Associate Deans (Research) and Department Heads in identifying mentoring opportunities

### *10.2.1 Early to Mid-Career Researchers (e.g., Queen's National Scholar)*

The QNS program, intended to enrich teaching and research in newly developing fields of knowledge, as well as in traditional disciplines, was a particularly effective program in support of early-mid-career researchers, and particularly those new to the University. The main criterion applied was academic excellence in both research and teaching.

Although the QNS program has been suspended, it is our recommendation that a revised and sustainable model be developed that would lead to the reinstatement of the QNS program<sup>34</sup>.

#### *10.2.2 Mid-Career (e.g., Research Excellence Prizes and Limited Term Scholar Awards)*

The QRC program has provided key support to a larger cohort of excellent researchers than the CRC program could provide for. Preference to external recruitment, the need for a retention strategy, and a desire to support underrepresented fields and areas, presented challenges for many universities and internal chair programs were established. The QRC program has provided support for up to 25 researchers at a level of \$20,000 per year for up to five years with the opportunity for renewal. While highly valued and deemed to be an important investment, the program as it presently exists, presents little opportunity for a larger number of faculty to compete for similar investments at a critical stage in their career.

We recommend that the QRC program be phased out. We recommend that a program be established to recognize emerging opportunities and timely developments in the research trajectories of mid-career researchers. This might take the form of a “research leaders” award for a period of up to two years (one-time award) and that a maximum of 10 new awards be made available in a given year (20 in steady state).

#### *10.2.3 Senior Researchers (e.g., Chancellors/University Professorships)*

We propose the establishment of Chancellors/University Professorships in recognition of a sustained career of accomplishment in scholarly and research activities and in leadership in advancing the University’s research reputation. We propose that this recognition be held by current faculty and that there be a prescribed maximum number of these professorships at any given time. These are intended to be honorary designations and should hold no sustained monetary commitment to the individual except for a one time award.

#### *10.2.4 Research Excellence Prizes*

The Prize for Excellence in Research, an internal award program, has existed for many years. The Prizes are awarded for major contributions while at Queen’s either completed in recent years or recognized in recent years for their significant impact. The Prizes may be awarded to persons in any of the fields or disciplines in which research is carried out at Queen’s. In any given year, it might be expected that one Prize would be awarded in the areas of the humanities and social sciences, and the second in the areas of the natural sciences, health sciences and engineering.

This program has been highly successful but is limited due to a number of factors. This is reflected in the relative representation of awardees from the humanities and arts and engineering

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<sup>34</sup> Principal Daniel Woolf announced the reestablishment of the QNS program at Senate, January 24, 2012.

in particular. The tendency to the natural and physical sciences and the health and life sciences in part reflects the emphasis on fundamental or basic research and an apparent bias against research that is judged to be “applied” (e.g., engineering). The perception that high impact journals including *Nature*, *Science*, *Proceedings of the National Academy of Science* provide a clearer indicator of international acclaim over other journals or publications contributes to this bias. The relatively few nominations from the social sciences, humanities and arts, particularly over the past two years, further exacerbate the problem. In fact, the OVPR has had to actively seek out nominations across the University in all areas this past year.

Building on Queen’s reputation in the Killam program, it would appear that our Research Prizes reflect the range of fields in the Killam Prizes. We propose that the number of Prizes be increased to up to five awarded each year, one in each of the five fields of health sciences, natural sciences, engineering, social sciences and humanities. We do not propose changes in the basic eligibility or criteria of the Research Excellence Prize. The Killam Prizes are not related to a particular achievement but rather are given in recognition of a distinguished career and exceptional contributions in one of these fields. We propose that the Senate Advisory Research Committee (SARC) sub-committees associated with the fields establish the criteria and be responsible for adjudicating nominations and recommendations to SARC.

## **11.0 Summary and Key Recommendations**

Part 1 of the SRP, *Guiding and Supporting the Research Enterprise*, serves as a roadmap, setting the vision for guiding and supporting research excellence, as well as strengthening Queen’s position as a top research-intensive institution and advancing our international reputation.

The Plan is guided by a set of principles focused on research excellence, supporting the academic mission, innovation, integration, integrated planning, compliance and accountability, and communication.

The objectives of the Plan are as follows:

1. Foster and enhance internationally recognized research programs and emerging research strengths.
2. Promote and enhance our research and scholarly activities that provide transformative experiences for undergraduates, graduate students and post-doctoral trainees.
3. Promote and enhance opportunities for collaborative and interdisciplinary initiatives between faculty across the University and with other universities and institutions.
4. Promote and enhance research partnerships that expand on our research strengths, increase the support for research, and enhance the delivery of research to stakeholders and partners locally, regionally, nationally and globally.

5. Advance diversity and inclusivity through research that leads to increased understanding of cultures and communities within Canada and abroad, and research that enables connections to people and the quality of their lives.
6. Encourage and support the translation and transfer of research outcomes, new knowledge and innovation for the betterment of society.

*Key recommendations include the following:*

### **Measuring our Progress and Success**

1. Increase the University's ability to assess weaknesses, opportunities and strengths for establishing planning and priorities.
2. Identify key performance indicators and an appropriate set of metrics to inform decision-making and investments.
3. Develop a performance monitoring template, where research performance and successes in meeting targets will be closely tracked and develop a best-in-class tracking system.

### **Processes/Mechanisms to Advance Research**

4. Invest in, and implement, an electronic research project management system (TRAQ).
5. Ensure timely communication and effective internal processes to convey information to the research community on changes to programs, policies and guidelines.
6. Strengthen internal and external research communications, including development of a new VPR website, producing strategic publications and promoting research excellence, accomplishments and impacts.
7. Explore options for providing expert, responsive and responsible services for support of major projects and new programs.
8. Provide opportunities for students at all levels and in all academic areas to participate in research (e.g., Undergraduate student summer fellowship; Inquiry@Queen's).
9. Foster the development of coordinated and collaborative management systems to ensure the sustainability of on and off-campus research infrastructure.

### **Innovation**

10. Foster knowledge translation where the outcomes of our research can benefit society. We are committed to advancing innovation through knowledge translation, commercialization, and through the development of Innovation Park.
11. Explore evolving emphasis on Open Access and new income models for peer-reviewed scholarly publishing.

### **Collaboration and Interdisciplinary Research**

12. Undertake a full review of the policy associated with the establishment and continued operation of Research Centres and Institutes. Research Centres and Institutes reflect the maturation and excellence of evolving collaborative efforts in important and emerging research areas for the University.
13. Establish an Institute for Advanced Research/Studies. The Institute will fulfill the mandate for developing a dynamic and evolving program focused on research excellence that is driven by the community of scholars and researchers drawn to the Institute responding to the most important questions and challenges.

### **Global Engagement and Internationalization**

14. Develop greater institutional coordination for global engagement and internationalization.
15. Increase global engagement by developing and expanding international research collaborations, partnerships and international development work.

### **Research Leadership and Excellence**

16. Develop and promote research leadership through achievements in excellence, CRCs, endowed and named chairs, and sponsored research chairs.
17. Review all internal research award programs and identify new ways to support programs.
18. Reinstate the QNS program.
19. Phase out the QRC program and introduce a Research Leaders award.
20. Establish Chancellors/University Professorships in recognition of a sustained career of accomplishment in scholarly and research activities and in leadership in advancing the University's research reputation.
21. Increase the number of Research Excellence Prizes to up to five awarded each year, one in each of the five fields of health sciences, natural sciences, engineering, social sciences and humanities.

## **Part 2:**

### ***Thematic Focus***

## **Part 2: Thematic Focus**

### **1.0 Queen's Research Mission**

Queen's distinguishes itself as one of the leading research-intensive institutions within Canada. Our mission is to advance research excellence, leadership and innovation, as well as enhance our impact at a national and international level. We are dedicated through our research and scholarly work to enriching the academic environment, transforming the student learning and post-doctoral experience, contributing to the cultural and economic growth of our country, and enhancing our international reputation. Through undertaking leading-edge research, Queen's is addressing many of the world's greatest challenges, and developing innovative ideas and technological advances brought about by discoveries in science, engineering and health. We will capture the creative energy of the human spirit and foster new perspectives of people and communities past and present through scholarly and creative work in the social sciences, humanities and arts.

Queen's upholds the commitment to the breadth and depth of the research enterprise, and recognizes the underlying value of ongoing support of individual scholarship, and by recognizing the important contributions to research excellence that continue to be made in this way. Increasingly, both individual and team researchers from across disciplines are working together to address the complex and diverse problems faced by society today. Facilitating collaborative and synergistic research is a particular goal. We are committed to interdisciplinary and collaborative initiatives across the University, throughout Canada, and through global partnerships.

We are committed to providing an unparalleled environment in support of our research and scholarly work. We seek to build on investments, including infrastructure, and to further develop emerging areas of strength across the spectrum of disciplines contributing to discovery, new insights, and creative works. Innovation will reflect the success of our academic programs, quality of our research and international reputation fueled by new ideas and methods, contributions to public knowledge through informed citizenship, commercialization outcomes, and knowledge translation where the outcomes of our research can benefit society broadly, whether directly or indirectly.

The purpose of this SRP (Part 1 - *Guiding and Supporting the Research Enterprise* and Part 2 – *Thematic Focus*) is to provide a roadmap for guiding and supporting research excellence at Queen's. The plan will be reviewed biennially by a Research Community Committee to ensure that it continues to meet the needs of the Queen's research community, as well as addresses new priorities that may evolve and be supported by traditional and non-traditional sources of research funding.



## 2.0 Framework for Planning

The Strategic Research Plan (SRP) is a result of broad internal and external consultation with Departments, Schools and Faculties, as well as industry and government. The Plan has been established to support and cultivate the research and academic environment and to provide a roadmap for maintaining and advancing Queen's position as a top ten research-intensive institution<sup>35</sup>. This is an institutional plan, which is informed by Faculty and Departmental/School plans. It does not replace, nor does it diminish, the value or importance of the unit plans.

We will continue to use the Canada Research Chairs (CRC), the Canada Foundation for Innovation (CFI) and the Ministry of Economic Development and Innovation (MEDI) programs to enhance areas of research strength and ensure that we have the critical mass of researchers and the associated infrastructure in strategic areas.

The Plan is guided by a set of principles focused on research excellence, supporting the academic mission, innovation, integrated planning, compliance and accountability, and communication.

Our strategic research objectives are to:

1. Foster and enhance internationally recognized research programs and emerging research strengths.
2. Promote and enhance our research and scholarly activities that provide transformative experiences for undergraduates, graduate students and post-doctoral trainees.
3. Promote and enhance opportunities for collaborative and interdisciplinary initiatives between faculty across the University and with other universities and institutions.
4. Promote and enhance research partnerships that expand on our research strengths, increase the support for research, and enhance the delivery of research to stakeholders and partners locally, regionally, nationally and globally.
5. Advance diversity and inclusivity through research that leads to increased understanding of cultures and communities within Canada and abroad, and research that enables connections to people and the quality of their lives.
6. Encourage and support the translation and transfer of research outcomes, new knowledge and innovation for the betterment of society.

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<sup>35</sup> See RESEARCH Infosource <http://www.researchinfosource.com/>. Research intensity is defined as total research income per full-time faculty position (full, associate and assistant faculty positions only were included).

### **3.0 Investment in Research Excellence**

#### *Research Leadership*

Queen's is a community of internationally recognized researchers and scholars who receive the country's highest recognition for their work. Their excellence has been recognized by major awards including Fellowships in the Royal Society of Canada, Steacie, Killam and Trudeau Foundation Fellowships, the Herzberg Gold Medal, Canada Council for the Arts Molson Prizes and Killam Prizes and Fellowships. We continue to cultivate this excellence and research leadership in new, emerging research leaders, and established researchers through the CRC program, sponsored, endowed and named chairs.

#### *Graduate Studies and Post-Doctoral Training*

Graduate students and post-doctoral fellows are essential contributors to quality research and teaching at Queen's. Much of the vibrant research conducted at Queen's depends on robust, productive and flourishing research collaborations between faculty, graduate students and post-doctoral fellows. We compete both nationally and internationally for qualified graduates and post-doctoral researchers and will continue to seek to invest in excellent graduate programs and support initiatives that bring excellent graduate students through interdisciplinary and collaborative graduate programs. We will continue to develop innovative training opportunities through programs such as NSERC Collaborative Research and Training Experience (CREATE) and Mathematics of Information Technology and Complex Systems (MITACS) and CIHR Strategic Training Initiative in Health Research (STIHR) programs to leverage our research strengths to enhance partnerships with other institutions and industry and integrate training of young researchers. More importantly, the training of graduate students is an important function of most faculty research programs and, thus, is supported broadly throughout the community and not just through designated training programs.

#### *Research Centres and Institutes*

Queen's researchers have historically been engaged in a wide variety of collaborative research projects and many of these collaborations have resulted in the development of Queen's Research Centres and Institutes. Research Centres and Institutes exist within all Faculties, within the Schools (currently Business and Law) and may also be University-based, which include those that are multi-disciplinary, crossing several Faculties, or even multi-institutional. Research Centres and Institutes are one of the important indicators of research strengths, excellence and interdisciplinary collaborative endeavours.

## *Infrastructure*

State-of-the-art research facilities are a key ingredient for delivery of high quality research and training programs in support of the University's strategic research priorities. The Isabel Bader Centre for the Performing Arts will open in 2013 and offer an unparalleled environment for arts presentation, learning and research-creation.

These research facilities play a key role in attracting excellent researchers and students. Queen's is at the forefront of supporting and leading major science platforms, along with collaborating universities, including the Sudbury Neutrino Observatory Laboratory (SNOLAB)<sup>36</sup> and the High Performance Computing Virtual Laboratory<sup>37</sup> (HPCVL). These facilities have also received significant CFI investments and represent significant research assets to be leveraged and sustained. Innovation Park provides another important dimension to our research infrastructure and capacity. The University is committed to a coordinated effort and engagement of all stakeholders in the planning and governance in support of new and existing investments.

## *Research Themes, Clusters and Signature Programs*

Queen's has identified four major research themes:

1. Exploring Human Dimensions
2. Understanding and Sustaining the Environment and Energy Systems
3. Creating, Discovering and Innovating, and
4. Securing Safe and Successful Societies

Within each theme, clusters have been identified which reflect emerging and core strengths as demonstrated by research leadership and international reputation, Research Centres and Institutes, and significant investments in competitive funding programs from one or more granting councils, Network Centres of Excellence, the Early Researcher Awards, the CFI, and MEDI (formerly Research and Innovation).

A number of clusters and areas of research within these clusters cross-over two or more of the themes, as does the research conducted by many scholars on campus. Signature programs are those particular areas of research and scholarly activity distinguished by specific investments (e.g., named, endowed and sponsored chairs; Research Centres and Institutes) and research opportunities (e.g., centres of excellence; major research platforms) where Queen's global leadership is expected to develop or has been established.

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<sup>36</sup> For more information, see <http://www.snolab.ca/>

<sup>37</sup> For more information, see <http://www.hpcvl.org/>

## **4.0 Research Themes, Clusters and Signature Programs**

### **4.1 Theme 1: Exploring Human Dimensions**

Exploring human dimensions cuts across several Faculties, Schools and Departments, where the nature of human creativity is explored through the examination and analysis of texts, the restoration of works of art, the critical evaluation of elements of modern culture, the theory-informed study of past human activity, and the creation of new knowledge and art, and its performance.

The study of the dynamics of human behaviour and the human mind provide a foundation for exploring the social dimensions of populations and communities and the study of learned systems of understanding. Increasing emphasis is being given to key and emerging ethical questions that arise in the relationships among life sciences, biotechnology, health, politics, law, and philosophy. Improving the human condition through an enhanced understanding of health, wellness, disease and aging, is essential to improving a wide range of aspects of both individual and social health, including that of the most vulnerable populations and communities.

#### Cluster: Society, Culture, and Human Behaviour

A significant community of scholars at Queen's are involved in the cluster of Society, Culture and Human Behaviour. Scholars working in this cluster often direct their research individually, rather than in teams, and with formative collaborative dialogue with other researchers and community partners taking place in global scholarly communications media and in a wide variety of cross-institutional and cross-disciplinary venues. Moreover, Queen's considerable science expertise in the School of Environmental Studies is strengthened by complementary research programs in philosophy, religion, and literature. A similar critical mass of expertise and interdisciplinary dialogue at Queen's has emerged in Globalization Studies, which draws together our expertise in sociology, political studies, economics, health studies, religion, gender studies, film and media, literature and history. Connections to communities and collaborative initiatives are increasingly becoming important elements to the research and scholarly work being undertaken in these areas.

Of particular importance to the vibrancy of the research carried out in this cluster is a high-quality University intellectual infrastructure (libraries, colloquia, visiting scholar series, performing arts centre) and the time dedicated to creative thought and dialogue. The new Isabel Bader Centre for the Performing Arts will be home to the School of Music, Department of Drama, Department of Film and Media and the Department of Art. The new Centre will include shared exhibition, performance and teaching spaces, and embrace the principle of interactivity and integration through common teaching rooms, joint courses, and shared public spaces and services.

Research groups and programs that support this theme area include: Assessment and Evaluation Group, Educational Theory and History of Education Group, Eighteenth and Nineteenth Century Studies Groups, Feminist Legal Studies Research Group, Gender Studies Research Group, Research Group in Linguistics, and Teaching of History Research Group.

Research areas within this cluster include: (1) Creation, Interpretation and Preservation of the Arts (2) Contemporary Culture (3) Composition (4) Mind, Language, Cognition, Knowledge, Ways of Knowing, and World Views (5) Theory, Regulation and Modification of Human Activity and Behaviour (6) Social, Cultural and Historical Change (7) Teaching and Learning in Social Contexts (8) Texts, Literatures and Contexts (9) Science, Technology and Culture (10) Cinema (11) Religion and Modernity (12) Economics (13) Geography (14) Globalization Studies.

#### Cluster: Human Health and Wellness

Research in this cluster includes the full range from basic biomedical research, applied clinical research, research on health care systems and services, biomechanics and human performance, to research on society, culture, and the health and wellness of individuals, populations and communities. This cluster is home to a number of research programs that span the social sciences, humanities and health sciences. Examples of such interdisciplinary research programs include: bullying, mental health and obesity, gender-based violence and HIV/AIDS, bioethics and end-of-life care, study of health economics, health and social service integration, reproductive and genetic engineering, reproductive ethics and social policy, and health and climate implications of urbanization.

Considerable cross-disciplinary health research also takes place in the Faculty of Health Sciences (FHS), its Schools (Medicine, Nursing and Rehabilitation Therapy) and its affiliated hospitals (Kingston General Hospital, Hotel Dieu Hospital and Providence Care), as well as in several other Faculties, Departments and Schools. The University is committed to working with the affiliated hospitals to advance health sciences research in Kingston and southeastern Ontario, as well as patient-oriented outcomes.

Health research is advanced through the many Research Centres, Institutes and groups on campus, including the Cardiovascular and Respiratory Research Centre, the Centre for Health Services and Policy Research, the Centre for Neuroscience Studies, the Centre for Studies in Primary Care, the Human Mobility Research Centre, the Canadian Institute for Military and Veteran Health Research, the Cancer Research Institute, the Clinical Evaluation Research Group, the Environment and Human Health Research Group, the Gastrointestinal Diseases Research Unit, Infection, Immunity and Inflammation (III) Research Group, International Centre for the Advancement of Community-Based Rehabilitation, Practice and Research in Nursing Group,

Protein Function and Discovery Group, and the Research Group in Reproduction, Development and Sexual Function. The thematically focussed research brings together investigators in the Schools of Medicine, Nursing and Rehabilitation Therapy, who are drawn from a range of disciplines, including: basic and clinical biomedical sciences, population studies and health services and policy research.

Foundational research strengths are structural biology, molecular medicine, research methodology and knowledge translation. Established, emerging and new research strategic strengths within this cluster include: (1) Neuroscience (2) Primary Health (3) Gastrointestinal Disease (4) Cancer (5) Musculoskeletal (6) Cardiovascular and Respiratory Diseases (7) Critical Care (8) Drug Development and Human Toxicology (9) Reproductive and Developmental Origin of Health, Disability and Disease (10) Chronic Disease Management (11) Disease Prevention and Wellness Promotion (12) Vulnerable Populations and Aging Populations (13) Mental Health (14) Military and Veteran Health (15) Pain (16) Rehabilitation.

#### **4.2 Theme 2: Understanding and Sustaining the Environment and Energy Systems**

Human well-being is increasingly dependent upon developing healthy human environments, understanding the external environment and the impact of human activities upon ecosystems, the adoption and development of renewable energy sources and sustainable energy systems and the implementation of informed energy and environmental policy. Knowledge of the ecology and fauna and flora in terrestrial and aquatic ecosystems across different biomes provides new insights and understanding of important factors associated with global climate change, human interactions, urbanization, and industrial activity. This is crucial information to better understand the threats to different species, habitat loss, habitat restoration and remediation, and to better inform policy development and actions that might be taken in relation to extractive industries, energy, water, and climate change.

Queen's researchers are leaders in their fields and are contributing in a range of areas including ecosystem management, renewable energy sources (e.g., wind and solar-generated power, supported by fuel cells and new energy currencies such as hydrogen), energy systems and design, materials science (e.g., nuclear materials, modeling materials behaviour, and nanomaterials), and biochemical and civil engineering (e.g., bioremediation, bioreactor design, and waste treatment).

Our priorities in this area include (1) Developing and enhancing the human aspect of healthy environments (2) Increasing depth in our understanding of ecology and the natural environment, particularly related to the 15 ecosystems of Canada (3) Developing sustainable energy systems and quantifying the performance of new systems, and (4) Supporting development of science-based energy and environment policy relevant to Canada's broad policy goals.

### Cluster: Human aspects of Healthy Environments

Queen's has established a strong foundation in environment and sustainability research involving multidisciplinary activity related to the human aspect of developing and enhancing healthy environments. This encompasses the workplace environment and occupational health, as well as the socio-cultural, legal and economic aspects of healthy environments. Examples of research within this cluster include: (1) Identification and characterization of environmental causes of human health problems (2) How labour and employment law can continue to advance workplace justice in ways attuned to today's economy and society (3) Examination of the role of organizational leadership in effecting sustainable organizational practices (4) Increasing efficiency in supply chains and using better information technology to improve sustainable practices (5) Examining changes in consumer behaviour towards more sustainable practices and the role of consumption in contributing to environmental degradation.

### Cluster: Ecology and the Natural Environment

Major environmental initiatives include the creation of the School of Environmental Studies, whose main areas of focus are: Environmental Chemistry and Toxicology; Ecosystem and Human Health; Society, Culture, Environmental Planning and Management, and Economic Sustainability.

Queen's University Biological Station (QUBS)<sup>38</sup> includes more than 3000 hectares of land and plays an integral role in the attraction and retention of excellent researchers and students. Biology, Geography and Policy Studies are key players in polar-regions and northern research and are bringing national and international attention to Queen's. Research in water is represented across a wide variety of disciplines and the goal of this research is to apply science and engineering innovation to move from unsustainable water use to long-term strategic fresh water systems throughout the world, tackling the water-related issues of the 21<sup>st</sup> century.

Researchers are addressing the impacts of natural-resource utilization (water, energy and minerals) on the environment and society, by bringing scientific and engineering knowledge of natural resources to bear on issues of social relevance nationally and internationally. They are also developing tools for municipalities to protect drinking water, developing chemical processes that are environmentally sustainable and new methods of environmental analysis, with the emphasis on detecting small organic compounds in water samples. In civil engineering, researchers are working on environmental assessment, remediation, biotechnology and analysis and are also seeking to understand sustainable water supply and regional groundwater flow in complex fractured rock environments and groundwater-lake interactions.

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<sup>38</sup> For more information on QUBS, see <http://www.queensu.ca/qubs/index.html>

Research groups and laboratories that enhance environment and sustainability initiatives include: the Groundwater Group/Flows Research Group and the Paleoecological Environment Assessment and Research Laboratory (PEARL).

#### Cluster: Energy Systems

Queen's research encompasses all aspects of energy research from the conventional, oil and gas, to carbon capture and storage, to the alternative, from solar, wind and nuclear technologies to smart grid applications and electric vehicles. Areas of research in conventional energy include: operations management, design optimization through energy and environmental process engineering, pipelines, biorefining, combustion, and contamination and clean-up. Carbon-capture and storage research includes homogeneous catalysis, carbon and nitrogen cycling, systems modelling: life cycle and GHG impact analysis.

Areas of research and developing areas of strength in alternative energy include: thermal systems, photovoltaic, turbulence, power, instrumentation, controls and modelling, design optimization of hybrid drive trains, grid systems and energy storage.

With an NSERC Research Chair in Nuclear Materials and with the Nuclear Materials group, world-leading research is being carried out in the area of structural materials for nuclear power applications. Research Centres in support of energy and environmental research are the Centre for Energy and Power Electronics Research and the Queen's-RMC Fuel Cell Research Centre (FCRC), a multi-institutional Centre, which includes faculty members from the Departments of Chemical and Mechanical and Material Engineering at Queen's, as well as from the Royal Military College of Canada.

Other research groups and laboratories specializing in energy research and developing areas of energy research include: the Nuclear Materials Research Group, the Thermal Hazards Laboratory, the Solar Calorimetry Lab, Solar PV and Wind Energy Research Field Laboratory, the Polymer Research Group, the Communication Laboratory, the Power Laboratory, and the Materials Physics Clean Room.

#### Cluster: Energy and Environmental Policy

Queen's is emerging to become a national leader in informing policy and investment decisions by government and industry by bridging the gap between research (both scientific and policy-based) and policy-making at the federal and provincial levels in energy and environmental policy, in cooperation with post-secondary institutions and corporate partners across the country. The School of Policy Studies, including Queen's Institute for Energy and Environment Policy, promotes bridging this gap between research and policy and its goal is to provide opportunity for the best academic research to intersect with the challenges of policy makers and industry.



Research areas in support of Environment and Sustainability have been identified as follows: (1) Ecology, Evolution and Conservation of Biodiversity (2) Environmental Measurement, Monitoring and Modelling (3) Environmental Chemistry and Toxicology (4) Environmental Change and Planning (5) Environmentally Sustainable Technologies (6) Northern Environments, Resources and Policy (7) Society, Culture and Economic Sustainability (8) Remediation and Protection of Soil and Groundwater (9) Water and the Environment (10) Integrated Environmental and Energy Policy.

### **4.3 Theme 3: Creating, Discovering and Innovating**

Queen's researchers are dedicated to creating, discovering, and innovating across all areas of the University. The foundations for innovation at Queen's are deeply connected to the pursuit of knowledge driven by curiosity and creativity expressed across the humanities and arts, social sciences, science, health, and engineering.

#### **Innovating through Knowledge Ecologies**

Innovation takes many shapes and forms in research. Innovation in its broader context is exemplified across Queen's in superior academic programs, research excellence, and international reputation. Innovation is also reflected in research that brings broad benefits to society as reflected in signature knowledge translation projects, through social innovation, which creates broad social value. We are seeking to innovate in new ways that build on our reputation in this area and one of the ways is through the formation of knowledge ecologies. A knowledge ecology involves the clustering of disciplinary approaches around a particular question of social, political, or academic importance. Patient care in Ontario's hospitals offers a good example. Typically the care of patients has been the domain of the medical school. But in a province where government seeks improvements to patient care as well as cost savings to sustain the healthcare system, where governments can provide research funds to grapple with such issues, and where patient-care advocates lament long waiting times and lack of personalized care, Queen's is ideally positioned to provide a knowledge ecology around such a question. Medical faculty and basic science faculty are the natural partners for such a research task, but in a knowledge ecology approach so too could be humanities and social science practitioners.

For example, a geographer might plot the layout of a hospital or develop the idea of the geography of grief, a literature specialist might investigate the narrative structures that underpin the medical case histories that are so vital to the practice of medicine, a philosopher might explore the underpinnings of the aspiration to cure, a playwright might work on patient-doctor interactions, and a political economist might shed light on the intersection between budget and ideology. Such an approach offers an inclusive research model that is adaptable to the changing

interests of government and private sector interests. It also yields richer, more complex, and more elaborate research findings in the public or private interest.

An example of a knowledge ecology, which is currently taking place on campus connects researchers from the social sciences and humanities with engineers to respond to central questions impacting ecologies and the natural environment including: what is waste? what do we do with it? and what is Canada's waste future?

Priorities in this theme of Creating, Discovering and Innovating include (1) Creating and producing nationally and internationally recognized performances, including music compositions, theatre productions, shows and screenings (2) Supporting foundational research and inquiry through exploration and discovery in the areas of the natural and physical sciences (3) Developing advanced materials, with improved physical, social or environmental properties over conventional alternatives, and in particular, green chemicals and polymers and nuclear materials (4) Creating advanced technologies, which can create new products or make existing processes "greener," thereby improving the lives of global citizens and their environments.

#### Cluster: Creative Production and Expression

Queen's is nationally and internationally renowned for its contributions to all forms of creative production and expression. Queen's is home to Juno award winning composers, several published playwrights and filmmakers who have had major shows and screenings, experts in the restoration of major works of art, as well as specialists in the history of art. Cultural Producers, from composers to documentary filmmakers, offer new ways of knowing, new means by which to reflect on experience and to engage with social, economic and technological change, as well as dimensions of citizenship, belonging and identity. Experimental and experiential learning and research are critical components of these programs for connecting researchers, artists and students locally, regionally and internationally.

Innovative research in creative production and expression is being undertaken by individual scholars as well as by researchers working across multiple disciplines. A specific example of this type of innovative research includes the collaborations of faculty members from the classics, mechanical and civil engineering, physics and art conservation to develop 3D imaging tools.

Research areas within this cluster include: (1) Drama (2) Cinema (3) Music and Composition (4) Art (5) Conservation of Art, Textiles and Artifacts (6) Performance (7) Contemporary and Historical Creativity (8) Research Creation in the Arts.

### Cluster: Natural and Physical Sciences

Science research in the natural and physical sciences currently engages a large number of faculty and research groups from a number of Departments across campus. These researchers are linked by a common desire to more deeply understand Nature's workings at a variety of scales from the Cosmos to ecosystems, to the brain, to the atomic scale, using various combinations of theory, experimentation and computation. Fundamental research is critical to unlocking the mysteries of the universe. Research in this cluster is foundational because it is driven by curiosity about the way the world works and because it provides the conceptual foundation for innovative and/or applied research at the University.

The work in this cluster is supported by significant funding from NSERC. Research facilities include the Chernoff Hall Chemistry Facility, Queen's Facility for Isotope Research and the High Performance Computing Virtual Laboratory (a four-university consortium led by Queen's that provides a leading-edge facility, as well as a portal to other national and international computing systems for complex calculations, data extraction and manipulation) and the Sudbury Neutrino Observatory Laboratory, a world-leading underground science laboratory specializing in neutrino and dark matter physics, led by Queen's and a consortia of four other universities.

Research areas within this cluster include: (1) Cognitive Science (2) Interdisciplinary Chemical Sciences (biological-medicinal, materials, computational-theoretical and environmental-analytical chemistry) (3) Earth System Science (4) Evolutionary Science and Genetics (5) Nanoscale Structures and Interactions (6) Origins and Structure of the Universe (7) Theoretical Science and Mathematics.

### Cluster: Materials

Queen's has long recognized the vital role that materials and manufacturing processes plays in enhancing our nation's prospects for economic growth and for facilitating and sustaining our competitive advantage in the global arena. We have built considerable strength in the understanding of the molecular properties of materials in advancing our ability to measure physical and chemical properties of materials. Advanced materials expertise is associated with CRCs in Mechanical and Materials Engineering, Engineering Physics, Chemical Engineering, Civil Engineering, an NSERC Chair in Nuclear Materials, and the Polymers Research Group.

Research areas within this theme include: (1) Innovative Materials (2) Materials Science.

### Cluster: Advanced Technologies

Discovery based research serves as the underlying foundation for innovations leading to advanced technologies. Advanced technologies arise as part original research, but the actual implementation of the results of research is a distinct and separate task that requires specialized

knowledge and resources. This is best exemplified by the role of PARTEQ Innovations and its success in advancing innovation arising from research at Queen's.

Queen's researchers have led and continue to lead in a number of areas. Advances in biochemical and chemical engineering have resulted in bioencapsulation technologies and two-phase partitioning bioreactors have led to US/Canadian patents and commercial licenses. Neuroscientists are developing robotic and software technologies for probing brain function and dysfunction. At the interface of advanced manufacturing and photonics, researchers are developing automatic real-time laser machining with in-line ultrafast imaging.

Queen's leads in the field of green chemistry and engineering, with recent innovations that include the development of switchable solvents and surfactants that provide a greener and less expensive alternative to costly and environmentally damaging organic solvents, allowing for the extraction of bitumen from oil sands with minimal water consumption and without the generation of tailing ponds, as well as new methods for cleanly recovering and recycling homogeneous catalysts.

Researchers are implementing new technologies using new materials for structural design and infrastructure replacement, and are applying computer science and equipment to computation, control and visualization of complex physical interactive processes. Application of computational science and visualization is conducted by a group of researchers from the School of Computing, Mechanical Engineering and Surgery who are developing and implementing world-leading computer assisted surgery techniques for orthopaedics through the Human Mobility Research Centre (HMRC). The Centre is a partnership between Queen's University and Kingston General Hospital (KGH) and serves as a point of collaboration between the disciplines of medicine, engineering, health sciences, and information technology.

Other laboratories also undertaking such multidisciplinary research include: the Percutaneous Surgery Lab, Medical Computing and Medical Image Analysis Lab, and the Medical Informatics Lab.

In addition to the advanced technology research on campus, Queen's researchers have access to the expertise of CMC Microsystems, located at Innovation Park at Queen's University. CMC delivers innovative and cost-effective services to microsystems researchers, facilitating the creation and application of micro- and nano-system knowledge by providing a national infrastructure and pathway to commercialization of related devices, components and systems.

GreenCentre Canada, founded by PARTEQ Innovations in 2009, and also located at Innovation Park at Queen's University, is a Centre for Excellence for Commercialization of Research and represents a growing cluster of strength in Kingston. Its purpose is to bring together academic

researchers and industry partners in a common goal of developing clean, less energy-intensive alternatives to traditional chemical products and manufacturing processes (see Creating, Discovery and Innovating). An important component to GreenCentre's success is Queen's continued leadership in the field of green chemistry.

Research areas within this cluster include: (1) Applications of Computational Science (2) Biomedical Applications (3) Biotechnology (4) Design and Rehabilitation of Infrastructure (5) Modelling and Control of Processes (6) Green Chemistry (7) Advanced Manufacturing Processes (8) Mechatronics and Robotics.

#### **4.4 Theme 4: Securing Safe and Successful Societies**

In the 21<sup>st</sup> century, there is real awareness that a web of social, physical, and technological forces influence the well-being of citizens, and scholars, from a range of sub-disciplines at Queen's, are actively studying methods and outcomes of efforts to secure our human, financial, political, and physical assets. When catastrophic natural events like tsunamis and earthquakes and human events associated with political change occur, and as internet developments bring risks and opportunities, research is needed to frame how these events affect both individuals and society. Current and potential research interests are outlined in three seemingly disparate sub-themes, but many fruitful and important research topics also arise that connect these areas.

Queen's is increasingly aware that securing safe and successful societies must be a defining component of our focus in the 21<sup>st</sup> century. Our priorities in this area include (1) Supporting democratic, economically viable systems of governance through active engagement in public policy (2) Improving the quality of information as well as the effectiveness, including the security, of communications tools, with particular focus on networks and telecommunications (3) Contributing to the secure design of infrastructure, with a focus on security of water and large resource extraction processes.

##### Cluster: Democracy, Economy, and Public Policy

The challenges of the global era are formidable: globalization; the expanding public world, rapid technological innovation; the restructuring of organizations in the public, private and non-profit sectors; human conflict over power, wealth and security; the increasing income disparity gap, the need for a highly educated citizenry; growing social diversity and demographic transitions; new conceptions of democratic governance; evolving foreign and defence policy, issues of international peace and security; rapidly changing workplace law as a result of influences such as changing demographics and globalization and the increasing collection and processing of personal data, particularly surveillance post 9/11.

Queen's University has deep research strength in these areas, rooted in the Faculties and Schools across campus. This is further reinforced by a set of active Research Centres and Institutes, including the Centre for International and Defence Policy, the Centre for Law in Contemporary Workplace, the Centre for Studies on Democracy and Diversity, the Institute for Intergovernmental Relations, the John Deutsch Institute for the Study of Economic Policy, the Monieson Centre, the Southern African Research Centre, and the Surveillance Studies Centre.

Research areas within this cluster include: (1) Communities, Conflict and Negotiation (2) Democracy, Identity and Citizenship (3) Health Policy and Law (4) International Relations and Development (5) Knowledge-Based Enterprises (6) Organizational Behaviour and Change (7) Social and Economic Development, Regulation and Policy (8) Values, Laws and Policies (9) International and Defence Policy (10) Labour and Employment Law (11) Surveillance.

#### Cluster: Information and Communications

There is a significant concentration of researchers at Queen's University working on information and communications technology within the engineering and science disciplines. A unique aspect of this research is the joint strength in the School of Computing, Electrical and Computer Engineering, Mathematics and Statistics and Film and Media. The research covers fundamental and applied aspects of (i) wireless technologies and telecommunications systems (ii) interconnectivity and (iii) information security. Research strengths encompass telecommunications, computer architectures and interconnection networks. A number of labs support information and communications research including the Human Media Lab, focussing on human-computer interaction; the Smart Information Management Laboratory, developing sophisticated computerized screening programs to mine billions of bits of data for evidence of terrorism, fraud and corporate crime; the Queen's-led High Performance Computing Virtual Laboratory, which provides secure HPC, data storage, software and services; and Software Analysis and Intelligence Laboratory, Canada's only ULSS software research lab.

Across Faculties, Schools and Departments, research ranges from computing applications and high-performance computing, to research on the application of new information technology devices to teaching and learning, and to business practices. Laboratories supporting this research include the Energy and Power Electronics Applied Research Laboratory, and a number of other labs and research groups, including: the Reliable Software Technology Group, Formal Languages and Automata Group, Modeling and Analysis in Software Engineering, Parallel and the Unconventional Computation Group. Many of these Groups and Laboratories provide support across several theme areas.

Research areas within this theme includes: (1) Computer Architectures and Interconnection Networks (2) Computational Science (3) Management Information Systems (4) Technological

Innovation and Society (5) Wireless Technologies and Telecommunications (6) High Performance Computing (7) Media studies and Mobile Learning.

### Cluster: Infrastructure

Security of infrastructure and water resources has been gaining heightened awareness within the public domain and Queen's researchers are undertaking important research to solve these security problems. Research strengths include: modeling, simulation and control of mining systems, blasting and mineral processing, structural engineering with a focus on various materials, such as concrete, steel, wood and other composites pertaining to the design, construction, maintenance and rehabilitation of structures such as bridges, building breakwaters and guideways.

Landfill design, landslide investigation and modeling, long-term degradation of dams, design of surface and underground works for mining and tunnelling, studies on shallow and deep foundations, including pipes, culverts and other buried infrastructure, as well as earthquake engineering are just a few of the areas of specialization undertaken by the researchers in Civil, Mining and Geological Engineering. The GeoEngineering Centre at Queen's-RMC support this research, as well as the following specialized laboratories: GeoEngineering large-scale buried infrastructure laboratory for buried pipe and culvert testing; geosynthetics liner longevity simulator laboratory, uniquely able to test durability under chemical, thermal, and mechanical loading; the Geotechnical shake table, focussed on reinforced walls; and the large reinforced wall test facility.

### **5.0 Summary**

The Queen's University SRP reflects our research excellence, our strength and innovation across a broad spectrum of disciplines. It reflects the University's response and commitment to finding our balance in a shifting landscape. The quality of our faculty, students, staff and research facilities and infrastructure provides a powerful basis for research performance that enhances Queen's reputation internationally and among the top research universities in Canada.

## Appendices

### Appendix 1: Evolution of a Research-Intensive University

Queen's University has a long history of academic excellence in both teaching and scholarly work undertaken by our faculty and students. The university's enviable record of achievement at both a national and international level is founded on a focus on excellence, unbridled curiosity and creativity, and a passion for research. Identifying the particular point in Queen's history when research emerged to be a major or strategic focus for the university is, however, difficult to pin down. What can be said about our present stature and the trajectory that propelled Queen's to this point most likely began in the late 1960s. During this time, a combination of hiring and emergence of the School of Graduate Studies and Research as a distinct academic administrative entity were key factors.

Resource requirements for research, including support for graduate students, and the competitive pursuit of funding had become a more important part of the research landscape at universities throughout the 1970s. The Office of Research Services was established, with a focus on the negotiation of research grants and contracts. Throughout the 1980s, Queen's developed into a research-intensive university. In 1991, Queen's was an inaugural member of the G10, a group of the top ten research-intensive universities in Canada. The goal of the G10 was to lobby the Federal Government for implementation of sound research policies, increased investments and the return of research overheads. Originally the G10, this group grew to become the G13, and has subsequently expanded (2011) to represent the top fifteen research-intensive universities (now referred to as the U15) in Canada.

By the late 1980s, Queen's researchers were receiving prestigious national research awards, such as the Steacie Fellowship (1989). This success continued on early into the 1990s, with awards received in 1990, 1992, 1994. The first Steacie Prize received at Queen's was in 1992, and the first Killam Prize was awarded to a Queen's researcher in the same year. Queen's currently ranks first in the number of national and international awards and prizes to faculty for research and scholarly work (e.g., Royal Society of Canada and Killam Prizes and Fellowships). Queen's places in the top five in Killam awards received.

Historically, Queen's has been home to some of the most distinguished scholars and contributors to Canadian society, including Dr. William Mackintosh, Professor and Head of the Economics Department in 1927 at the age of 32, winner of the very first Royal Society Innis-Gérin medal, the Society's highest honour for a Social Scientist and credited for building the Economics Department into one of Canada's leading departments; Dr. Arthur Lower, Professor of History, and one of Canada's most eminent historians, and; Dr. John Meisel, whose teaching career in Political Science at Queen's began in 1949. Dr. Meisel's philosophy of student-centred learning,



his pioneering work in research and his service to Canada through contributions to a number of Royal Commissions and Advisory Boards has gained him numerous teaching, research and service awards, including Companion of the Order of Canada.

The Office of the Vice-Principal (Research) continues to provide dedicated support for the advancement of nominations and applications for awards, prizes, fellowships, and recognition of research excellence at the national and international level. A partial list of faculty who have recently garnered significant recognition include Susan Cole, Will Kymlicka, Audrey Kobayashi, David Lyon, Art McDonald, John McGarry and John Smol, and continue to garner recognition for their achievements in diverse areas of research and scholarly work that spans particle physics, climate change and the environment, cancer research, ethnic and linguistic diversity, conflict resolution, surveillance and privacy, and cultural systems and practices.

The early 1990s also saw Queen's emerge to become the new scientific and administrative home to larger national and international initiatives, or signature projects, including Insect Biotech Canada, a Network of Centre of Excellence, NCIC Clinical Trials Group, and the Sudbury Neutrino Observatory (SNO). Formation of the SNO scientific collaboration, which consisted of the University of California at Irvine, Princeton, Oxford, Queen's, Carleton, Guelph, Laurentian, the National Research Council (NRC) and the Atomic Energy of Canada Limited (AECL), began in the 1980s. The SNO Institute was set up by Queen's, together with Carleton, Guelph and Laurentian as member institutions, to administer the SNO project and was formalized through the Queen's Senate in 1989. A significant investment in capital funding at the level of \$85 million between 1990 to 1999, from the Federal and Provincial Government, the US and UK led to the construction of the project located 2 km underground in INCO's Creighton Mine, near Sudbury, Ontario. In 1995, the Office of the Vice-Principal (Research) was established in response to the explosion of research programs introduced by the Federal government.

From 1978/79 to 1993/94, research funding increased from about \$6 million per year to about \$68 million, with research growing as a percentage of operating revenue from about 6% to approximately 34%. Research funding remained constant between \$60 and \$70 million up until 1999/2000, when the number of clinical trials taking place at Queen's increased, Canada Research Chairs program and Canada Foundation for Innovation were established, and researchers began receiving funding from provincial programs including the Ontario Research and Development Challenge Fund (ORDCF) programs (the forerunner to the Ministry of Research and Innovation (MRI) and now Ministry of Economic Development and Innovation (MEDI) ORF programs).

From 2000/2001 to 2001/2002, a dramatic increase in research activity led to the breaking of the \$100 million mark in research funding, with totals reaching \$127 million. These increases reflected Queen's competitiveness in research programs supported by the CFI and the provincial

program, such as CFI, ORDCF (now Ontario Research Fund) and the Ontario Innovation Trust (now Ministry of Research and Innovation grants)<sup>39</sup>.

In 2009/10, Queen's research revenue was \$166 million. This represents a substantially funded enterprise, and while accounted separately from the operating revenue of the university, it is approximately 42% of the \$391 million operating revenue reported by the university<sup>40</sup>.

Although research revenue is an indicator that is often utilized for the basis of success, it is not a measure of the quality or of the importance of research but simply a reflection of its cost. Queen's research excellence can be attributed to the quality of the research carried out on campus and to the dedication to one's discipline and furthering the knowledge and innovation within one's field or cross-disciplines.

The link to funding, though, is a critical feature of our research programs and signature projects. Receipt and management of public and private funds requires universities to be accountable, transparent and compliant with respect to the certifications associated with various research programs. An institutional commitment to support this and the securing of funding is essential if Queen's is to maintain its competitive position amongst the leading research-intensive universities in the country and globally.

### *Innovation and Commercialization*

Queen's first tentative steps toward support of innovation and commercialization research began in the 1930s, with a \$4,000 investment in the medical research of Dr. Hendry Connell, an eye, ear, nose and throat doctor, whose enzyme solution ("Ensol") for treating cataracts showed early (although subsequently unfulfilled) promise as a cancer treatment.

The WWII years were characterized by extensive applied research in such areas as the treatment of war wounds, radar detection, nuclear fission processes, and the development of metal alloys and microwave devices.

The postwar era saw Queen's support for innovation grow. In 1945, the university contracted with an Ottawa firm for patenting and licensing assistance, and in 1953, it established an Inventions Committee. The number of invention disclosures from staff and faculty grew at such a pace that by 1977 Queen's hired its own in-house patent agent.

In 1985, supported by provincial funding, Queen's launched its first permanent office of research commercialization, The Canadian Enterprise and Innovation Centre (CE/IC), in recognition of

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<sup>39</sup> Queen's Report on the Annual Budget 2000-2001

<sup>40</sup> Queen's Report on the Annual Budget 2010-2011

the potentially beneficial impact of technology transfer on the university and the community. When the province's financial commitment to technology commercialization ended in 1987, Queen's support did not. Adopting what it saw as the best aspects of technology transfer elsewhere in North America, it restructured the CE/IC as a separate, not-for-profit organization, giving it the autonomy to function entrepreneurially while still reporting to the university. Renamed PARTEQ Innovations, its mandate included protecting and licensing Queen's intellectual property and, where warranted, developing startup companies.

By the mid-1990s PARTEQ's licensing revenues had topped \$500,000 and its startup companies had attracted more than \$1 million in investment. By the end of the decade PARTEQ had expanded its services, managing nearly \$10 million in venture funds, and by the early 2000s it had returned more than \$20 million to the university. In 2009, it became the first university-based technology transfer office in Canada to be awarded a National Centre of Excellence for Commercialization and Research.

Now in its 26<sup>th</sup> year, PARTEQ manages its own Angel Network and locally funded venture fund, has returned more than \$30 million to the university and its inventors, and has facilitated the creation of 44 worldwide spinoff companies that have attracted more than \$1 billion in investment.

## **Appendix 2: Strategic Research Plan Revision Process**

The current *Queen's University Strategic Research Plan (SRP)* was first established in February 27, 2003, and updated January 26, 2006. It will be substantially revised over the coming year as we proceed with developing our academic plan for the University. A comprehensive and consultative process for revising the *Strategic Research Plan* will be implemented. It is expected that the review process will take place over a 12-14 month period. The proposed process is described below.

### ***Collecting Ideas - Research Community Input***

- A Research Community Committee will be formed. It will be composed of:
  - 2 faculty members from each Faculty who are representative of the research community
  - Representation from 2 university and 2 Faculty-based Research Centres/Institutes
  - 1 Undergraduate, 1 Graduate Student and 1 Post-Doctoral Fellow Representatives
  - 1 Queen's Scholar and 3 Canada Research Chair representatives (minimum of one representative from each of the natural, physical and engineering sciences, medical, and social sciences and humanities areas)
  - Representatives (2) of the research support/administration community
  
- This committee will provide initial input into topics such as what directions in research may be advanced in a strategic manner and how we might prioritize and subsequently support these strategic directions; what should the structure of the plan look like

### ***Consultation with the Faculties***

- Primarily through the Associate Deans (Research), the Faculties will be asked to provide input on the suggestions generated by the Research Community Committee and to provide additional input on potential strategic directions and how they might be pursued

### ***Broad Community Consultation***

- An initial and brief document will be prepared by the VP (Research) that will stimulate conversation and invite input regarding the Strategic Research Plan
- At Town Hall meetings, the document and ideas will be discussed
- The document will be posted on a website set up to accept submissions from the community

Responses to the document will be encouraged via VPR team participation in Faculty, Department and as appropriate, staff and student meetings.

### ***Draft 1: Strategic Research Plan***

- This will be prepared by the VPR who will receive support from academic and others involved in the consultation process (including a “scribe” who will attend all meetings and consultations to record comments and discussion)
- The draft will first be sent to the Senate Advisory Committee on Research (SARC) for view
- The draft reviewed by SARC will be widely disseminated for input, including posting on the website

### ***Penultimate Draft: Strategic Research Plan***

- Review by Faculties
- Review and approval by SARC before forwarding to Senate for final approvals

### ***Proposed Time Line***

*Approval of the Process: 2 Months (including consultation, SARC and Senate Approvals)*

*Collecting Ideas: 3 months, beginning January 2011 (Jan to March)*

*Consultation with Faculties: 2 Months (Apr to May)*

*Broad Community Consultation: 4 Months (June to September)*

*Draft Strategic Plan: 1.5 Months (Sept to Oct)*

*Posting and Dissemination of Draft for Feedback: 1.5 Months (Nov to Dec)*

*Penultimate Draft: 1 month (Dec -Jan)*

*Review by Faculties and Possible Town Halls: 1.5 months (Jan-Feb)*

*Queen’s Planning Committee (for consultation and information)*

*Approvals: SARC and Senate (Spring 2012)*

## **Appendix 3: Research Indicators**

### **A. Discipline, Field, Faculty Specific**

- distinctiveness of the research program (emerging or promising area of strength and distinction)
- peer-reviewed funding
- ability to be the leader in the field
- the potential to attract outstanding faculty, graduate students and, if applicable, post-doctoral fellows
- amount of funding received for on-campus infrastructure
- number of awards with graduate/post-doctoral fellows/technician stipend support
- support from Deans and Department Heads (especially including financial support, space and other tangible evidence of support)
- number of undergraduate/graduate students involved
- the potential to attract support for administrative/management expenses and/or support for indirect costs
- critical mass of faculty
- assessment of impact on field – by external referees

### **B. Bibliometric**

- number of top-tier journal publications
- number of articles published in peer-reviewed journals
- number of citations relative to discipline norms
- H-index, contemporary h-index
- Eigenfactor
- Article Influence scores
- citation analysis tools: Web of Science and Publish or Perish
- book publications and publisher

### **C. Economic and Social**

- improving the health and/or social well-being of citizens
- economic benefits from improved efficiencies or infrastructure and other
- number of jobs created as a result of new technology
- degree, kind and number of community outreach experiences
- impact of program on public welfare
- educational impact
- success and impact on the careers of our graduates
- demand for graduates
- reduction of health care costs

- stimulation of economic development in the city and region through creation of spin-off companies or the provision of expertise and access to resources for existing companies
- number of students graduated and employed
- growth of sustained or sustainable companies

**D. Knowledge Translation/Transfer, Commercialization and Innovation**

- number of contracts with industry
- number of awards with equipment grants
- diversity of external support sources
- contribution to technology transfer, patentable discoveries and licensed technologies
- number of inventions, computer programs, scientific breakthroughs in various fields
- knowledge transfer activities as assessed by external referees
- # faculty on guideline panels translating evidence to practice/field
- development of knowledge tools (e.g., patient/provider protocols in health care or other fields)

**E. Local, regional, national and global**

- amount of funding support for international research and international development projects
- degree of faculty involvement in major national policy development
- significance of contribution by faculty and staff in national leadership positions in academic, research and professional bodies to influence policy
- strength of relationship with City
- number of successful private or public sector partnering opportunities
- visibility/profile of research program with stakeholders
- number of international and national research awards
- examples of international research partnerships
- number of citations in international publications relative to discipline norms
- global impact
- number of invited talks at national and international conferences
- participation in learned discourse and conferences

**F. Comprehensive and multidisciplinary research**

- number of faculty involved from different Departments and Faculties
- significance and impact of cross-Departmental/cross Faculty initiatives
- amount of cross-Departmental co-supervision of graduate students
- number of universities involved in initiative

- extent of interdisciplinary activity and collaborative research



#### Appendix 4: Signature Programs

Signature programs are those particular areas of research and scholarly activity distinguished by specific investments (e.g., named, endowed and sponsored chairs; university based centres and institutes) and research opportunities (e.g., centres of excellence; major research platforms).

1) Named, Endowed and Sponsored Chairs:

- i. Alfred Bader Chair in Organic Chemistry
- ii. Alfred and Isabel Bader Chair in Northern Baroque Art
- iii. Alfred and Isabel Bader Chair in Southern Baroque Art
- iv. Baillie Family Chair in Conservation Biology
- v. Bell Canada Mental Health and Anti-Stigma Research Chair
- vi. Bracken Chair in Genetics and Molecular Medicine
- vii. Cancer Care Ontario Research Chairs: Health Services Research, Medical Imaging and Experimental Therapeutics
- viii. Chair in Mine Design, Government of Ontario
- ix. David Chadwick Smith Chair in Economics
- x. Donald and Joan McGeachy Chair in Biomedical Engineering
- xi. DuPont Canada Chair in Engineering Education Research and Development in the Faculty of Applied Science
- xii. Edith and Carla Eisenhower Chair in Clinical Cancer Research
- xiii. Gordon and Patricia Gray Chair in Particle Astrophysics
- xiv. Hannah Chair in the History of Medicine
- xv. James H. Day Chair in Allergic Diseases and Allergy Research
- xvi. Jarislowsky-Deutsch Chair in Economic and Financial Policy
- xvii. Mining/Mechanical Engineering Chair
- xviii. Noranda-Falconbridge Chair in Mine Mechanical Engineering
- xix. NSERC Chair in Design Engineering
- xx. NSERC Chair in Nuclear Materials
- xxi. NSERC Chair in Minerals and Metals Processing Engineering
- xxii. NSERC/RIM Industrial Research Chair in Software Engineering
- xxiii. Ontario Research Chair in Bioethics
- xxiv. Ontario Research Chair in Green Chemistry and Engineering
- xxv. Sir John A. Macdonald Chair of Political and Economic Science
- xxvi. Stauffer Dunning Research Chair
- xxvii. Stauffer Chair Cancer Research
- xxviii. UNESCO Chair in Arts and Learning

- 1) Networks of Centres of Excellence
  - a. Promoting Relationships and Eliminating Violence (PREVNet), Knowledge Mobilization Initiative Networks
  
- 2) University-based Research Centres and Institutes
  - a. Canadian Institute for Military and Veteran Health Research (CIMVHR)
  - b. Centre for Neuroscience Studies (CNS)
  - c. GeoEngineering Centre at Queen's-RMC (GeoEng)
  - d. High Performance Computing Virtual Laboratory (HPCVL)
  - e. Human Mobility Research Centre (HMRC)
  - f. Southern African Research Centre (SARC)
  - g. Sudbury Neutrino Observatory Laboratory (SNOLAB)
  
- 3) Faculty-based Research Centres and Institutes
  - a. Cancer Research Institute (CRI)
  - b. Centre for Energy and Power Electronics (ePOWER)
  - c. Centre for Health Services and Policy Research (CHSPR)
  - d. Centre for International and Defence Policy (CIDP)
  - e. Centre for Law in Contemporary Workplace (CLCW)
  - f. Centre for Studies in Primary Care (CSPC)
  - g. Centre for Studies on Democracy and Diversity (CSDD)
  - h. Fuel Cell Research Centre (FCRC)
  - i. Institute for Intergovernmental Relations (IIR)
  - j. John Deutsche Institute for the Study of Economic Policy
  - k. Queen's Institute for Energy and Environmental Policy (QIEEP)
  - l. Surveillance Studies Centre (SSC)
  - m. The Monieson Centre

## Appendix 5: Canada Research Chairs

Name	Primary Department	Exploring Human Dimensions		Understanding and Sustaining the Environment and Energy Systems				Creating, Discovering and Innovating				Securing Safe and Successful Societies		
		Society, Culture and Human Behaviour	Human Health and Wellness	Human Aspects of Healthy Environments	Ecology and the Natural Environment	Energy Systems	Energy and Environmental Policy	Creative Production and Expression	Natural and Physical Sciences	Materials	Advanced Technologies	Democracy, Economy and Public Policy	Information and Communications	Infrastructure
<b>TIER 1</b>														
Bergin, James	Economics	√												
Carrington, Tucker	Chemistry				√				√		√			
Cole, Susan	Pathology and Molecular Medicine		√											
Croy, Anne	Biomedical and Molecular Sciences		√											
Davies, Peter	Biomedical and Molecular Sciences		√											
Funk, Colin	Biomedical and Molecular Sciences		√											
Hawryshyn, Craig	Biology		√		√				√					
Jain, Praveen	Electrical and Computer Engineering					√					√		√	
Jia, Zongchao	Biomedical and Molecular Sciences		√											
Kymlicka, Will	Philosophy	√										√		
Lillicrap, David	Pathology and Molecular Medicine		√											
Liu, Guojun	Chemistry								√	√	√			
McGarry, John	Political Studies	√										√		
Moore, Ian	Civil Engineering						√							√
Munoz, Doug	Centre for Neuroscience Studies		√											
Nickel, Curtis	Urology		√											
Nunzi, Jean-Michel	Chemistry								√	√	√			
Peppley, Brant	Chemical Engineering					√			√		√			
Piomelli, Ugo	Mechanical and Materials Engineering					√			√					

Rowe, Kerry	Civil Engineering				✓		✓		✓	✓				✓
Smol, John	Biology				✓		✓		✓					
Thomson, David	Mathematics and Statistics				✓				✓		✓		✓	
<b>TIER 2</b>														
Allingham, John	Biomedical and Molecular Sciences		✓											
Boulay, Mark	Physics, Engineering Physics and Astronomy								✓					
Cahill, Catherine	Biomedical and Molecular Sciences		✓											
Cameron, Laura	Geography	✓			✓									
Day, Troy	Mathematics and Statistics		✓	✓	✓				✓					
Daymond, Mark	Mechanical and Materials Engineering								✓	✓				
Docoslis, Artistides	Chemical Engineering								✓	✓				
Dorris, Michael	Biomedical and Molecular Sciences		✓											
Fam, Amir	Civil Engineering									✓	✓			✓
Grogan, Paul	Biology				✓				✓					
Groome, Patti	Community Health and Epidemiology		✓											
Janssen, Ian	School of Kinesiology and Health Studies	✓	✓	✓										
Jessop, Philip	Chemistry					✓			✓		✓			
Johnsrude, Ingrid	Psychology	✓	✓											
Kuhlmeier, Valerie	Psychology	✓	✓											
Latimer, Amy	School of Kinesiology and Health Studies	✓	✓											
MacLeod, R. John	Biomedical and Molecular Sciences		✓						✓					
Mozersky, Joshua	Philosophy	✓							✓					

Murakami Wood, David	Sociology	√										√		
Noble, Anthony	Physics, Engineering Physics and Astronomy							√						
Rau, Wolfgang	Physics, Engineering Physics and Astronomy							√						
Scott, Neal	Geography			√		√		√						
Soederberg, Susanne	Global Development Studies	√										√		
Stroman, Patrick	Diagnostic Radiology		√											
Thorburn, Malcolm	Law	√												
Troje, Nikolaus	Psychology	√	√					√						
Waldman, Stephen	Mechanical and Materials Engineering		√					√	√	√				
Zulkernine, Mohammad	School of Computing												√	