Queen's University

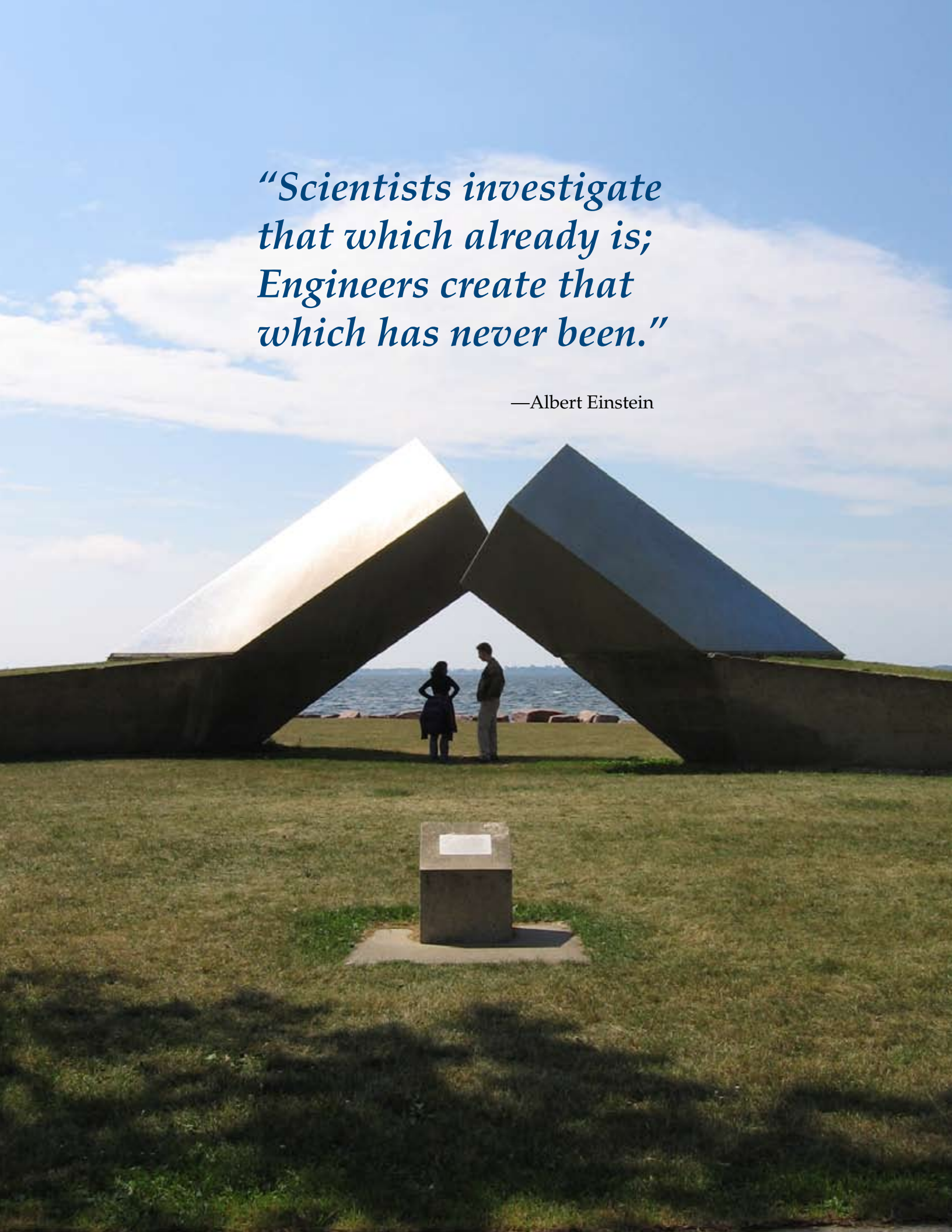
Renowned Spirit, Unrivaled Excellence

The Faculty of Applied Science at Queen's University

Strategic Framework 2012

Educating Leaders for the 21st Century

June 2009



"Scientists investigate that which already is; Engineers create that which has never been."

—Albert Einstein

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MESSAGE FROM THE DEAN

The Faculty of Applied Science has a long and proud history. Its roots stretch back to 1893 with the charter of the School of Mining and Agriculture in Kingston.

From its inception, the school's founders—engineers such as Sir Sandford Fleming, Dr. W.L. Goodwin and the Faculty's founding Dean, Nathan F. Dupuis—had a clear vision of the institution that the country needed, and of the institution that they would create.

In 1894, the Faculty of Applied Science at Queen's University was created as a degree granting institution and, with its amalgamation with the School of Mining and Agriculture in 1916, the Faculty we now know was born.

Since that time, the Faculty has maintained a reputation for excellence—a reputation as a leader in the delivery of the very best engineering education available. We are justifiably proud of that reputation, and are committed to preserving and enhancing it as we move forward in the 21st century.

Confronting us today is an economic climate in which we face declining government funding, challenging financial markets and increasing competition from other Universities. If we are to maintain our position at the forefront of educational excellence in Canada, we must adapt.

We must explore new, innovative funding solutions, and we must continually renew our curriculum to prepare our students to take their place as the industry leaders of tomorrow.

We must focus on new areas of study while building on our core strengths in traditional fields.

We must continue to build on our relationship with our alumni, as they are our greatest source of strength and passion.

This strategic plan seeks to carry forth the vision of the Faculty's founders, building on our history of excellence in teaching and research, and adapting to the challenges of today in order to create an institution that will nurture the leaders of the 21st century.

Kimberly A. Woodhouse, PhD., P. Eng., FCAE, FBSE
Dean, Faculty of Applied Science

THE PLANNING PROCESS

The strategic framework was developed in consultation with faculty members, students, staff and alumni over the last year.

A draft plan was first developed in collaboration with the Heads of the Faculty of Applied Science Departments. This was followed by extensive consultation with the faculty members, students, staff and alumni through focus groups and department meetings.

The plan presented in this document is the result of these consultations and forms the outline for a detailed operational plan.

The background portion was developed through the evaluation of documents on the direction of engineering both nationally and internationally; directions in engineering education; information about population; and funding trends and government policy.

Of particular use were:

- "Engineering for a Changing World: A roadmap to the future of engineering practice, research and education from the Millennium Project (MP)" at the University of Michigan;
- "Setting our sights on Canada's 2020 Prosperity Agenda", May 2008 (Institute for Competitiveness and Prosperity)(ICP);
- The National Survey on Student Engagement (NSSE);
- The Provincial and Federal government budgets;
- Statistics Canada;
- The Queen's University Strategic Plan; and
- Reports from the National Council of Deans of Engineering and Applied Science (NCDEAS), the Canadian Council of Universities (COU) and the Ontario Council of Universities.

1. THE VISION

OUR VISION

Educating Leaders for the 21st century

The Faculty of Applied Science at Queen's University builds on a tradition of spirit and loyalty to provide a distinctive learning experience at the frontiers of engineering innovation

The overall strategy for achieving this vision is one of balanced focus. To be a Faculty with influence in the future global academy and to continue to attract high quality faculty members in the face of predicted labour shortages, we need to enhance our research intensiveness while continuing to enrich the undergraduate programs, programs at the heart of the Faculty since its inception.

Over the next three years, the Faculty will evaluate all aspects of its program with a particular focus on the rationalization of the number and structure of offerings over which the Faculty has academic control. At present we offer, in collaboration with the Faculty of Arts and Science, 6 engineering programs, 4 engineering science and mathematics programs, with over 30 options or streams. It is questionable whether this number of offerings meets the needs of our students or is sustainable. The complexity of these programs makes it difficult to respond quickly with changes in curriculum and contributes to high teaching loads. The teaching is predominately at the undergraduate level, inhibiting the development of a strong graduate program, hampering faculty recruitment and significantly constraining the capacity of the faculty members to interact with students and meet the research goals of the University.

The curriculum renewal proposed at the undergraduate level is extensive. With this renewal, the common first year, considered core to the strength of the Faculty of Applied Science, will remain for the 6 programs housed within the Faculty of Applied Science. In response to competitive pressure from the University of Toronto and the University of Waterloo, discussion continues on the concept of fundamentally altering the acceptance and recruitment strategies around some of the engineering science programs.

A thread that occurs throughout the strategic framework is that of leadership. The Faculty of Applied Science will focus on the development of technically strong but well-rounded individuals with an interest in a balanced educational experience. The Faculty of Applied Science community at Queen's University believes that leaders in the 21st century will adhere to the principles of applied sustainability as a given and will have strong backgrounds in global policy, economics and business upon graduation.

At the heart of applying concepts of sustainability is a commitment to conceiving, designing, implementing, and managing human activities in a way that assures an overall contribution to both human and ecosystem well-being over the long-term. Human activities that generate such contributions are compatible with the application of sustainability concepts; those that undermine either over the long-term are not.

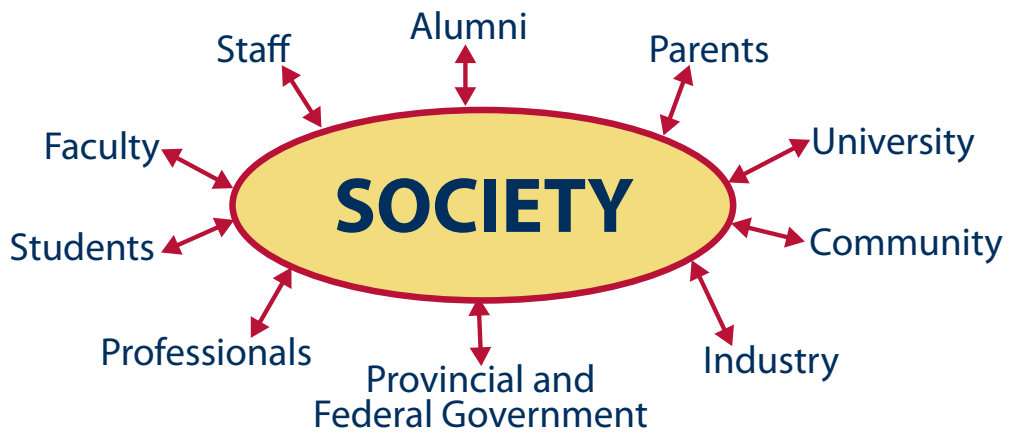
Our Values

- Quality and excellence
- Collaboration with integrity
- Respect for others
- Ethics
- Applied sustainability

Our Mission

We educate engineering students for leadership and citizenship in a global society through high quality, technically rigorous engineering programs.

Our Stakeholders



2. THE CHALLENGES WE FACE

2.1 THE ECONOMIC FACTORS

Around the world, countries are struggling with the current economic crisis.

That crisis aside, Canada has a fundamentally strong economy. However, our gross domestic product (GDP) per capita is $8800 (2007) less than that in the United States. This gap is considered an unmet opportunity by the Institute for Competitiveness and Prosperity, an independent organization that serves as a research arm for the Ontario government through the Ministry of Economic Development and Trade. The Institute sees a focus on people and technology as a key driver for Canadian prosperity, most particularly in Ontario.

On average, Canadians have a lower level of education than that of our counterparts in the United States. This is particularly true at the University level (ICP, AUCC, and National Center for Education Statistics in the US). Of particular relevance to this strategic framework, Canada is falling behind in its funding of public post secondary education in comparison to our nearest competitor, the United States.

In 2005, the public expenditure for public post secondary education per capita in the United States was approximately $3000 (CDN, 2005) while in Canada it was approximately $2400. The investment in public education in the United States increased by 25% per capita from 1980 to 2005, while the Canadian investment decreased by 20% (AUCC documents). The difference in combined revenues from government and net fees between public institutions in the United States and Canada was $8000 (CDN, 2005) per student.

Exacerbating the problem in Ontario is the relative provincial investment compared to other provinces. According to recent statistics from the Council of Ontario Universities, operating grants per student in Ontario are $6052 compared to an average across the other provinces of $8500. This places Ontario last in the nation in per capita funding to Universities. The province has been in last place for 15 years.

The student/faculty ratio within Ontario has risen from an average of 17:1 in 1993 to 26:1 today. In comparison, U.S public institutions have a ratio of approximately 14.8:1 and Alberta and British Columbia have ratios of 20:1 and 21:1 respectively (COU and ICP).

Both the federal and provincial governments have made significant contributions to research and graduate studies through such instruments as the Canada Foundation for Innovation, the Canada Research Chairs, the Ontario Research Fund, the SuperBuild Fund and strategic granting programs. Interestingly, Canada is 16th among 17 comparator nations in PhD's awarded (Conference Board of Canada Report Card), and awards one-half fewer Masters Degrees per capita and one-third fewer PhDs than the United States.

On a more positive note, Canada out-invests the United States in university research and development with Canada contributing significantly more relative to its GDP (ICP).
The Ministry of Research and Innovation (MRI) in Ontario has highlighted the need to focus

research funding and to develop metrics to track efforts to build an innovation-intensive economy within its strategic plan (Strategic Plan for MRI, 2006). The plan emphasizes excellence, value and strategic importance for world leadership in innovation and commercialization. The Ontario government, through the MRI, is highlighting commercialization within the University sphere, noting that, while Ontario Universities are very good at creating start-up companies (30% more per million dollars invested than in the US), the number of patents per million dollars invested is 62% of that in the United States and income per patent license is 19%. The Ministry of Research and Innovation has a specific focus on increasing post-secondary enrolment in science and engineering.

The Federal government has committed to science and engineering through its Advantage Canada economic plan. The science and technology strategy termed "Mobilizing Science and Technology to Canada's Advantage" has a key theme of innovation to commercialization. Four areas for focus have been defined:

- environmental science and technology;
- natural resources and energy;
- health and related life sciences and technologies; and
- information and communication technologies.

The Faculty of Applied Science is well placed in all four areas to compete for government funding.

2.2 THE PROFESSION

Several factors are affecting the profession of engineering, particularly in Western nations and specifically within North America. Studies have highlighted the global knowledge economy driven by technological innovation and the changing international workforce as significant influences on engineering practice in North America (MP).

Competition from large numbers of highly-trained, talented and less-expensive engineers from other countries, particularly India and China, requires that North American engineers provide additional expertise in policy, global economics, project management, and applied sustainability and be prepared, upon graduation, to work in a global engineering and business environment. Abilities to innovate and problem solve creatively are seen as critical skills for this generation of engineers, with the emphasis on creativity.

There is a drive towards the completion of graduate degrees as a requirement for professional licensure and an educational model that more closely resembles that of medicine and law, where engineering becomes a second practice based degree (MP). The shift has already started in the United States where licensing bodies in Civil Engineering are going to require a Master's degree for a professional license.

Engineers Canada, our national accrediting institution, issued a report on the emerging areas of engineering in August 2007. It, along with work undertaken at the Millennium Project, and the Global Summit on the Future of Mechanical Engineering, have indicated that emerging areas in engineering include:

- green or sustainable engineering;
- systems and complex systems engineering including systems biology;
- mechatronics;
- engineering and health technologies; and
- nanotechnology.

The mechanical engineering report "2028 Vision for Mechanical Engineering" states "Mechanical engineers over the next two decades will be called upon to develop technologies that foster a cleaner, healthier, safer and sustainable global environment."

At the present time, engineers are in high demand in the resource sector including water and infrastructure development, and in sustainable engineering practices involving all aspects of social, environmental and economic factors. Engineers are also in demand in the public health sector where modelling, environmental monitoring, and pandemic evaluations are driving the need for civil engineering, chemical engineering and mathematical modelling expertise.

In 2007, the Ontario Government created a review panel to make recommendations to assist the Canadian electricity sector in solving the significant labour shortage projected in the coming decade(s).

2.3 INTERNAL CHALLENGES

The Faculty of Applied Science is at a critical juncture.

The Faculty is coming under increasing pressure to differentiate itself through innovative curriculum, outstanding research and high-quality teaching. The Faculty is also under significant external competitive pressure primarily from the expansion of engineering programs across the country at both the undergraduate and graduate levels creating unprecedented competition for highly qualified students. The Faculty of Applied Science is dealing with a significant shortfall in enrolment at both the undergraduate and graduate level and stabilizing our total enrolment while maintaining the high quality of our programs is a key focus of our long-term strategy.

We face a particular challenge in the graduate area. We are currently constrained by infrastructure limitations in both the quality and quantity of research space. The Faculty is dealing with laboratory and research infrastructure that is not appropriate for leading edge research initiatives. In addition, faculty member teaching loads are too high, constraining our ability to access graduate and research funding at levels needed at a research-intensive university, a 'must' in today's post-secondary environment.

2.3.1 Undergraduate

Who comes to the Faculty of Applied Science? Roughly 23% of applicants indicate Queen's Applied Science as their first choice, approximately 21% of the students have averages over 90% and 22% are women. A high proportion of our students come to Applied Science because of the common first year. We find that 52% of the students change their mind from the initial indication they provide on program preference to when they choose their final program in the spring of first year. In addition, Queen's University has a reputation for quality and high standards. One of the governing principles of this strategic framework is a focus on maintaining and increasing that quality.

The National Survey on Student Engagement (NSSE), designed to measure first and senior year student views on activities known to be associated with positive educational outcomes, includes over five hundred American universities and nineteen Ontario universities.

The G13 is a group of leading Canadian research-intensive universities formed to support joint research programs. The universities in this group include the University of Alberta, University of British Columbia, University of Calgary, Dalhousie University, Université Laval, McGill University, McMaster University, Université de Montréal, University of Ottawa, Queen's University, University of Toronto, University of Waterloo and the University of Western Ontario.

We have NSSE comparison data for 11 faculties of applied science/engineering from within the G13. For first year students, the Faculty of Applied Science at Queen's University ranks:

- #1 for activities associated with the level of academic challenge and supportive campus environment;
- #2 for activities associated with active and collaborative learning and enriching educational experiences; and
- #3 in student-faculty interactions.

Interestingly, and of concern, is that our ranking for activities associated with the level of academic challenge moves from 1st to 10th in the assessment by graduating students and active and collaborative learning moves from a rank of 2nd to 5th. Survey questions within the metric of academic challenge include several key indicators of complex learning skills, analyzing, synthesizing, making judgements and applying knowledge. Questions in the active and collaborative learning area include questions on project work within class, community based projects, class interactions and discussion within the classroom setting. These trends, which are in areas critical to the practice of engineering, are of great concern given our initiatives in integrated learning. They highlight the need for positive change in our curriculum to focus program choice to allow for more interaction between faculty and students.

2.3.2 Research and Graduate Studies

In the Faculty, we have 450 graduate students with approximately 55% in Master's degrees and 45 % in PhDs. Of these, 72% are domestic students. The average number of students per faculty member is approximately 4.

Queen's University has seen a 21% increase in Tri-Council funding from 2003 to 2007, approximately 3% above the average for other G13 Universities. However, the University has the second lowest number of Canada Research Chairs in comparison to other G13 universities. There has been an 87% increase in the amount of sponsored research funding since 2000; however, this is below the average of the G13 schools. After rising in 2002 and 2003 to 4th overall, in 2005 our research intensity fell to 7th behind McMaster University, University of Toronto, McGill University, University of Alberta, University of Ottawa, and Université de Montreal respectively but in 2008 rebounded to 4th once again.

Queen's University has seen a 5.7% increase in full-time faculty since 2000, with the average of the G13 universities at 4%. However, our research dollars per full-time faculty member is below the average for all the G13 institutions. The average publications per year per faculty member at Queen's (one indicator of research output) for Natural Sciences and Engineering is approximately 1.5, significantly lower than that of the University of Toronto, McMaster University, the University of Alberta and McGill University but higher than

University of Waterloo and University of Calgary. Our impact factor using the average relative impact factor (ARIF), which measures the probability of a published article being cited in another journal, was approximately 1.1, placing us 8th out of the G13 in relative impact factor.

2.3.3 Personnel

Our ability to hire new faculty members will be highly constrained until 2016 unless significant new money can be found through industry, government and endowed professorships and chairs. A skew in the number of professors in Electrical and Computer Engineering in comparison to the students going into those programs presents a particular challenge to the Faculty from a hiring, budget and a teaching load perspective. At present, any new faculty hiring increases the base operating deficit within the Faculty.

The retirement profile for the academic staff shows that the 'baby boom' phenomena will begin to impact the Faculty in 2019 with a significant increase in the number of retirements. These retirements will provide the budget for an equally significant number of new faculty hires. However, this assumes that in the face of no mandatory retirement, retirement will only be delayed by two years on average, which is the trend generally found in jurisdictions where mandatory retirement has been lifted. Unfortunately, the window for new faculty hires will coincide with a predicted national labour supply shortage at the Ph.D. level.

Of equal concern is the retirement profile of the support staff. Across the Faculty, we will start to see large numbers of staff beginning to retire in 2012 with approximately 33% of the staff turning over by 2021. Given the current budgetary environment, this represents a significant challenge in succession planning, particularly with shortages in labour predicted within the same timeframe.

2.3.4 Budget

The Faculty of Applied Science is running both an annual budget deficit and an accumulated debt from the previous years. This is not an uncommon situation in the current university environment in Ontario. In 2007-2008 and 2008-2009, base budget transfers have been used, not to decrease the deficit but to increase the number of faculty positions in Departments other than Electrical and Computer Engineering. In particular, Civil Engineering is past the limit of its ability to manage the growth at both the undergraduate and graduate level with student to faculty ratios that are the highest in the Faculty.

Decreasing the student to faculty ratios across the Faculty, commensurate with high quality programs, is critical to attracting students, providing high quality graduate supervision and research growth. Positions in Mechanical and Materials Engineering are focused on hiring in the new Biomechanical Engineering Option. This program is expected to increase significantly the number of women in the Department of Mechanical and Materials Engineering, helping to maintain our outstanding record in attracting women to the Faculty. In addition, it will support the recruitment of graduate students to the Faculty of Applied Science and Queen's.

At the undergraduate level, the Faculty of Applied Science invests significantly less base operating funding for equipment than other Ontario engineering schools. This has resulted in a crisis in our ability to support the active 'hands on' learning, which is

critical to the distinctive educational experience provided at Queen's. Outdated laboratory and teaching facilities seriously undermine recruitment efforts. In response, starting in 2008/2009, $250,000 per year is being dedicated to ongoing equipment replacement. At present, this funding is being found from a variety of sources including the base budget and carry forward. Our carry forward/contingency at the Faculty level is projected to be essentially depleted by 2012.

The Faculty of Applied Science faces a significant shortfall in enrolment. Indeed stabilizing our enrolment at 2,600 undergraduate students and 455 graduate students, while maintaining the quality of the programs, is the primary focus of our long-term strategy. After four years of decline in the period 2004/2005 to 2007/2008, full time undergraduate enrolment has increased. We have made significant inroads into our enrolment issues at the undergraduate level through new recruiting initiatives including a video designed with the help of students. The growth outside the targets of 2600 undergraduate and 455 graduate students will be attained through distance learning initiatives into the GTA and through international collaborations.

3. STRATEGIC THEMES RESULTING FROM THE VISION STATEMENT

Four strategic themes emerged from our vision statement. These themes guide the development of our key, long-term, strategic goals.

1. LEADERS FOR THE 21ST CENTURY

Our faculty and students will be leaders for the 21st Century.

Our faculty and students will:

- Share a global perspective;
- Crave creativity and innovation;
- Solve new problems with critical thinking and traditional skills;
- Be sensitive to the needs of policy and changing politics;
- Bring an understanding of applied sustainability;
- Have a deep understanding of business;
- Be effective communicators with strong interpersonal skills;
- Work well within a team environment and project management structure, while maintaining an entrepreneurial spirit; and
- Be independent and self directed-learners.

2. TRADITION OF SPIRIT AND LOYALTY

We embrace our tradition of spirit and loyalty.

Our faculty and students are:

- Keenly aware of our sense of accomplishment and the pride that accomplishment engenders;
- Committed to student involvement, independence and ownership;
- Cohesive, cooperative and collegial;
- Committed to the community and the residential experience that Kingston has to offer;
- Connected to the rich tapestry of our alumni network; and
- Committed to breaking down barriers, whether in scholarship, research or project management.

3. DISTINCTIVE LEARNING EXPERIENCE

Queen's offers a distinctive learning experience.

Our faculty and students choose us because:

- We offer a unique graduate and undergraduate experience, compared to other international and national universities;

- We offer a flexible and responsive curriculum, which is centered on a core set of principles;
- We encourage faculty and students to engage in active learning and project driven activities within and across disciplines;
- We embrace innovative teaching techniques through the use of high quality facilities;
- We are inclusive, and therefore able to adapt and respond to the dynamic needs of a changing student population;
- We engage in creating independent thinkers and self-taught leaders; and
- We learn from each other in a unique community environment where individuals interact as citizens, collaborators and leaders as much as they do as teachers and students.

4. FRONTIERS OF ENGINEERING INNOVATION

Our faculty and graduates will be on the frontiers of engineering innovation because we:

- Understand the need for interaction between engineering, technology, social sciences, physical sciences, health and biological sciences, humanities, business/commerce and law;
- Strive to ensure that our teaching and research is relevant, both now and in the future;
- Are sensitive to the global climate in which we live;
- Embrace emerging technologies;
- Enhance our strengths in energy, natural resources, bioeconomy, communications, advanced materials, biomechanics and nanotechnology research; and
- Maintain a core curriculum which can be readily and rapidly adapted to meet society's changing need for expertise.

4. THE WAY FORWARD: HOW WE WILL ACHIEVE OUR VISION

4.1 LAUNCHING NEW INITIATIVES IN LEADERSHIP, INNOVATION AND ENTREPRENEURSHIP FOR THE 21ST CENTURY

Leadership, innovation and entrepreneurship emerged as very strong themes throughout all the discussions with students, alumni and faculty. In education and engineering literature, leadership is now defined as including innovative solutions to traditional and non-traditional engineering problems. There is an emphasis in North America on engineers becoming innovators with new models for engineering design that include creativity and creative problem solving techniques.

The initiative in Innovation and Entrepreneurship in Engineering will integrate efforts across the Faculty and could include awards for inventions for Faculty members, graduate students and undergraduate students. In many cases, the design stream within the Departments will be the methodology employed to integrate new opportunities to teach creative problem solving, innovation, policy, and business background. The emphasis here will be to develop a program that fosters creativity in both the technical and business environments.

We will provide a Leadership initiative to educate students across the Faculty in team dynamics, business cases, project management, and entrepreneurship. The Engineering Society will be actively engaged, with a view to providing the practical component of the theory through the design teams and student services. This could take the form of workshops, not-for-credit course offerings or may be woven into a 5-year certificate program.

Leadership, Innovation and Entrepreneurship Highlights

- Professorship/Chair in Innovation in Engineering
- Two Endowed/fully funded Design Chairs
- Award for a Faculty Member who patents an invention
- Award for a graduate student who patents an invention
- Award for an undergraduate student who patents an invention
- Faculty-wide program in Leadership

4.2 EMBRACING OUR TRADITION OF SPIRIT AND LOYALTY

4.2.1 We will increase our service learning initiatives throughout the curriculum by 2012

One of the challenges that the Faculty and the University face is nurturing their relationship with the local community. Service learning within the curriculum will both help to improve those relationships and enhance the educational experience of the students.

4.2.2 We will provide two Faculty communications per year to alumni and other stakeholders commencing June 2009

Alumni and other stakeholders care passionately about the Faculty and its future. We will make continuous, clear communication our highest priority.

4.3 ENHANCING OUR DISTINCTIVE LEARNING EXPERIENCE

4.3.1 We will have the equivalent of 15% of the faculty operating budget revenue generated through private mechanisms by 2012

Private mechanisms imply non-government base budget grant funding and include national funding agency funding (chairs and indirect), indirect funds from research contracts, and endowments. These will be developed to support both current and new program initiatives. This will require a planned strategy for chairs and professorships for current faculty members and any new hires.

We will have 200 students in distance learning and/or professional programs by 2012

Key to our continued ability to receive government funding will be growing our undergraduate program. The undergraduate program could be expanded through distance learning into the GTA. While this fundamentally changes the Queen's residential experience, it would provide a way for us to:

- meet the Government's need for postsecondary education in the GTA;
- leverage the population growth in that area with relatively low start-up costs; and
- enhance our diversity.

Professional development programming will also be investigated as a revenue generating method.

4.3.2 We will maintain an undergraduate population in Kingston of 2600 by 2012

We have already undertaken significant work to enhance our recruiting efforts. A professional video has been produced highlighting the top 10 reasons for coming to the Faculty of Applied Science, and we are utilising web-based technologies to interact with applicants, including providing an Applied Science portal for each applicant to the Faculty. These initiatives have resulted in an increase in enrolment to 699 in first year in September 2008.

4.3.3 We will maintain a graduate population of 455 by 2012

We will match undergraduate recruitment efforts at the graduate level. Participation at graduate recruitment fairs will be increased, the Faculty website enhanced to highlight research and graduate opportunities as well as the undergraduate programs and undergraduate research opportunities increased.

We have initiated the replacement of outdated teaching and laboratory facilities by committing $250,000/year starting in 2008-2009.

We will have 5 new research chairs by 2012

Obtaining research, industrial or endowed chairs for current members of our faculty

would greatly increase the flexibility to hire. We have talented and internationally acclaimed researchers who are qualified for chair positions. In addition we have a large number of professors who work extensively with industry and may be eligible for industrial professorships.

4.3.4 We will implement an undergraduate and graduate curriculum that incorporates the concepts and practical application of policy, social responsibility, change management, teamwork, and environmental and cultural awareness by September 2012

This will be undertaken by moving to a new structure within our curriculum and actively promoting dual-degrees and internship programs. We will develop three separate 5-year streams for students to expand their expertise in engineering and business innovation, policy, leadership, and socially responsible engineering (i.e. applied sustainability).

4 + 1 Certificate programs

This program would be offered for students who do not want to undertake a graduate degree and will be course-based or course-based with an internship. It will be self-supporting.

Certificate in Applied Sustainability

The focus of the first certificate will be in Applied Sustainability. Aboriginal community initiatives will also be included in this first certificate as part of the internship component. This certificate program will mirror that offered at the graduate level but with courses at the undergraduate level. It will likely require an internship for completion. In the focus groups it became apparent that applied sustainability has a broad applicability across the Faculty and that, within the Faculty, international development projects and initiatives with aboriginal communities have more specific appeal to certain student groups.

4+1 Professional Masters Programs

The two new Professional Masters programs will be in Applied Sustainability and in Mineral Resource Management.

Masters in Applied Sustainability (2012)

The purpose of the proposed Masters Degree in Applied Sustainability is to explore the theory and practical implementation of sustainability-compatible engineering. There are many potential areas of application. Three obvious examples are:

- the broad range of applications included in the engineering design philosophy currently being explored in Civil Engineering related to provision of fundamental needs and services—water, food, and shelter;
- mineral resources management – encompassing the full project life cycle from exploration through to mine design, operation, and long-term post-closure; and
- surety of energy supply: long-term energy policy and the appropriate mix over time of conservation and the various forms of primary and secondary supply; the more specific issue of long-term management of used nuclear fuel.

This Masters degree may or may not require an internship. An internship within a graduate program is relatively unique. The Masters in Applied Sustainability, the Humanitarian engineering program and aboriginal community initiatives are already well underway

in their development and will be integrated into one comprehensive degree. The Masters in Applied Sustainability is proposed as a program within Applied Science but open to students from a variety of disciplines and backgrounds.

Masters in Mineral Resource Management (2012)

This degree will be supported through the proposed Centre for Mineral Resource Management. It will be the first of its kind offered in Canada and will be open not only to students in applied science, but in other fields including law, business, economics and policy. The mandate of the program will be to prepare the graduates to assume leading roles in mineral resource management in Canada and abroad. Students in the program from fields other than science and engineering will receive instruction in geology-mining basics, while those with geology-mining backgrounds will be able to enhance their technical expertise. All students in this program will take a common core of interdisciplinary courses in the broader legal-policy-business fields.

4.4 PUSHING THE FRONTIERS OF ENGINEERING INNOVATION

4.4.1 We will build a new Applied Science building with construction initiated by 2012.

The building will be designed and built consistent with our emphasis on innovation and applied sustainability. It will incorporate interdisciplinary research clusters while preserving departmental identity by having undergraduate and graduate common space contiguous with departmental offices. This will be of particular importance to the Department of Mechanical and Materials Engineering which is currently located in four separate buildings.

Centres/Institutes: All centres described in this part of the plan are designed to enhance or build capacity within the Faculty in key areas whether at the Faculty or University level. New centres/institutes under consideration are in Mineral Resource Management. A centre with a focus on Communications is under development through Electrical and Computer engineering in collaboration with the Department of Mathematics and the School of Computing. Current Faculty Centres will be maintained according to the Queen's University policy. These Centres include GeoEngineering at Queen's-RMC, the Queen's-RMC Fuel Cell Research Centre, the Human Mobility Research Centre (HMRC) and the Centre for Sustainable Bioeconomy. Key to the initiation of new Centres and maintenance of current ones will be the interdisciplinary and leading edge research supported under each combined with a strong faculty member commitment.

4.4.2 We will have an Institute/Centre for Energy (EIQ) by 2012

Conceptually this Institute might combine the Fuel Cell Research Centre (FCRC) with key areas of strength across the Faculty, including a Centre in Energy and Power Electronics Research (ePOWER) which has been granted provisional status. The focus will be on alternative energies, energy and fluid systems, nuclear energy and aspects of the bioeconomy. The Faculty of Applied Science is well positioned to be a leader in this research area.

4.4.3 We will have a Centre for Mineral Resource Management by 2011

To address the present and future personnel and knowledge needs of the mineral resource industry, this Centre will have an integrated, holistic approach to education. It will incorporate a Masters in Mineral Resource Management by 2012. This will be a $25 million initiative and will include programming applicable for all departments.

4.4.4 We will implement a collaborative Masters degree in Biomedical Engineering by September 2010

As mentioned previously, Biomedical Engineering is an exciting field of study that offers tremendous growth opportunity. With the creation of this degree, the Faculty stakes its claim to a leading role in its development.

The Faculty's future is bright.

Its strengths are formidable:

- a faculty of talented and dedicated researchers and teachers;
- a student body drawn from the very best and brightest;
- a group of the most passionate and committed alumni
- a team of highly skilled and experienced support staff; and
- one of the most honoured and respected histories of any engineering institution in the country.

It is now time to build on those strengths and adapt to meet the challenges posed by a new century.

And we will.

Queen's engineers will continue to take their place as leaders, both at home and abroad, building a bright, sustainable future for the benefit of all.

The Faculty of Applied Science at Queen's University

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