

# York University Strategic Research Plan: 2018-2023

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## Executive Summary

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## Research Vision

York University is committed to excellence in research and scholarship in all its forms. Informed by a strong commitment to shared values, including the promotion of social justice and the public good, we aspire through our research to better understand the human condition and the world around us and to employ the knowledge we gain in the service of society. Intensive engagement in research is a core institutional value that permeates the fabric of the University, and it is this foundation on which York's vibrant and exciting academic environment is built.

## Introduction

York University acknowledges its presence on the traditional territory of many Indigenous Nations. The area known as Tkaronto has been care taken by the Anishinabek Nation, the Haudenosaunee Confederacy, the Huron-Wendat, and the Métis. It is now home to many Indigenous Peoples. We acknowledge the current treaty holders, the Mississaugas of the New Credit First Nation. This territory is subject of the Dish With One Spoon Wampum Belt Covenant, an agreement to peaceably share and care for the Great Lakes region.

A strong commitment to acknowledging our colonial history and exploring indigenous ways of knowing are central to York's contribution to building a stronger, more inclusive, Canada.

### **Expanding Critically Engaged Scholarship with Increasing Impact on Communities and Society**

As York University approaches its sixtieth birthday, research, scholarship and related creative activity have never been more vibrant or more prominent amongst the University's ambitions. There is a sense of excitement at York surrounding its engagement in critical scholarship that is fueled by its growing success and recognition as an internationally leading research intensive comprehensive university emphasizing real world impacts. From modest beginnings 59 years ago within a small liberal arts college, research at York has evolved with a unique perspective and strong commitment to working across disciplines that is essential to solving the most complex, intractable problems of 21<sup>st</sup> century society.

The growth of research scholarship and related creative activity has accelerated markedly over the past decade. Never has there been greater opportunity, success, or challenges facing scholarship at York. The expanding bedrock of world leading scholarship in the social sciences, humanities, education, law, science, and business has been accompanied by rapidly growing new leadership in health and engineering research that is broadening and deepening York's impact on communities. As York prepares to welcome a new campus in 2021, together with multiple new investments in research and research infrastructure across the Keele and Glendon campuses, the future of critically engaged scholarship at York has never been brighter. At the same time, while external supports for research, as well as opportunities for engagement and impact, continue to grow, increasing competition and complexity

within the Canadian and Ontario postsecondary system means the challenges facing researchers have never been greater.

York's strong planning environment and strategic commitment to support its research base, while investing broadly to grow research strengths and more specific areas of research opportunity, provides a strong institutional framework upon which to grow individual and collaborative research success. The prominence of *Advancing Exploration, Innovation and Achievement in Scholarship, Research and related Creative Activities* in York's Academic Plan (2015-2020) emphasizes the importance of continued growth and success in this area to the overall success of the institution. York's academic plan:

highlights primary goals of research intensification and recognition driven through international standards of peer review, with an emphasis on research cultures, and the advancement of partnerships locally, regionally and internationally

The Academic Plan makes strong commitments in ten areas to growing the success of research at York over the next five years from a commitment to increase the base of research engagement and scholarly outputs across disciplinary boundaries, increasing external research partnership and community engagement, to growing and enhancing student and postdoctoral fellow engagement and establishing York as an innovation hub that combines research translation and entrepreneurship with a focus on social justice and impacts on communities.

Similarly, Research and Innovation feature prominently in York's Strategic Mandate 2 that formalizes ambitions and expectations for York with the province of Ontario for 2017-2020. Here the government recognizes York as:

*"a global centre for interdisciplinary scholarship based on a commitment to comprehensive and STEAM programming as fundamentally important knowledge and experience to meeting the needs of a global knowledge economy in the 21<sup>st</sup> century".*

Thus, the importance and prominence of research, scholarship and related creative activities has never being higher at York. This Strategic Research plan provides the next level of detail in articulating our plans for translating research ambition into research success and research impact.

Over the next five years York is committed to increasing recognition of our research, scholarly and creative work through broadly based increased participation in research across the institution by full time faculty and trainees at all levels, accelerated growth in the number and diversity of our scholarly outputs and research funding base, and growing the impact of our work through broadening and deepening our external partnerships and engagement in the generation and sharing of knowledge. Our goal is to show international leadership in research, scholarship and associated creative activity as one of Canada's and Ontario's leading research universities.

#### **A Plan Developed through a Broad Process of Collegial Engagement.**

The success of academic plans depends on the engagement of the academic community in the planning process. From the announcement of the strategic research planning process in the fall of 2017 through the presentation of the plan for Senate approval in the spring of 2018, the York community has

undergone an intensively open and attentive discussion about the role of research, our valuation of research and our aspirations for the future of research at York. Guided throughout the process by an active and dedicated advisory committee with representatives from the University and the broader community, the Office of the Vice-President of Research and Innovation has actively reached out to solicit input from the York community, emphasizing the broadest possible level of consultation in keeping with York's practice of collegial governance. The input from faculty members, students and staff was invited through a series of open fora and community consultations on campus and through an active web portal that invited engagement in the planning process, posting summaries of what was said at all events, as well as a page for comments and suggestions. Essential inputs into the plan's development were provided directly by the Faculties through their councils and advisory committee representatives, as well as through the Academic Policy, Planning and Research Committee of the Senate and other research leadership bodies.

Once again, the York community has shown an enthusiastic response to the planning process that has highlighted our valuation of and aspirations for research at York in the context of the overall academic mandate of the University. This plan takes up those aspirations in providing guidance for the growth and development of research at York for the next five years.

#### **A Commitment to Quality, Academic Freedom, Inclusion and Social Justice**

York strives for the highest academic standards and its strong commitments to academic freedom and social justice and responsibility are woven into the University's fabric. It is the unwavering support of these values by every member of the York community from which the institution derives its strength. The support for these values is a foundational principle of the Strategic Research Plan. It is critical to York's overall success that faculty continue to enjoy maximal liberty in the choice and pursuit of their scholarly work. By holding research and advancement of knowledge across the full spectrum of disciplinary and interdisciplinary activities as essential and integral to our academic mission, York contributes to critical inquiry, scientific discovery and the social and economic development of Canada and beyond. Informed and supported by the consultation process, the values and core principles shared by our research community serve to strengthen and underpin our research priorities.

York is intensifying and building on our research strengths across traditional and non-traditional areas of research, scholarship and creative activity, as reflected by international standards of peer review. We recognize as a community that individual research and scholarship is the foundation upon which the research enterprise at York is built. Only with this solid foundation can we expect to successfully expand our reputation for research excellence. As a community, we acknowledge the importance of graduate students and postdoctoral fellows to the success of our research and scholarship and we are committed to providing them with the best possible supports as they pursue their training.

At the same time, the York community understands the value of collaborative research and the importance of translating discovery into action. We seek to engage the world around us in collaborative, participatory, and partnered research that is inclusive, builds long term relationships and brings tangible benefits to the communities with which we work. York has seized on the opportunities provided within a comprehensive institution to make long-term investments in supporting participatory and collaborative research and scholarship that cross the boundaries of traditional disciplines and that reach out into York

Region, Canada and the world. York's emphasis on interdisciplinarity in its strategic research development provides national and international leadership in the promotion of new approaches to research and scholarship. In particular, York is committed to working with Indigenous communities and York-based Indigenous scholars to deepen our understandings of respectful forms of research engagement, development and application. Additionally, the last five years have seen the emergence of a strong culture of entrepreneurship and innovation across the University led by student engagement that is emphasizing the translation of ideas and research outcomes into tangible cultural, environmental and economic benefits to communities and society.

### **Comprehensive Research Excellence with International Reach**

York researchers have played key roles in many of the most important scholarship and discoveries of the past half century. They include discovery of the Higgs boson and the exploration of Mars; changing the way we think about youth marginalization and homelessness; developing novel approaches to health care delivery; developing insight into social and political history of Canada and understanding the environmental changes brought about by colonial expansion on indigenous societies; advancements in computer and biological vision and probing the impacts of digital gameplay; studying the formation and development of language policy in Canada; generating new insights into brain development in children with autism and intellectual disabilities across the lifespan; and discovering that lifelong learning involves adaptations that are linked to the brain's performance; encouraging civic dialogue through performance and public art; working to improve the global plight of refugees and exploring immigration solutions; shaping future thought on suburbanization and today's ecological crisis; mapping the spread of infectious diseases through mathematical modelling; and studying virus-resistant plants to bolster the survival of agricultural crops and combat the effects of climate change.

Research at York is strongly engaged internationally and has demonstrable and meaningfully global impact. Indeed, over the past five years, York has led all Ontario Universities, with over 55% of publications resulting from the collaboration of two or more authors having at least one author from outside of Canada. York has over 200 active research partnerships with international institutions that form the basis of much of the collaboration and which enable the movement and exchange of researchers and trainees.

Leading examples of the international reach of York's research include: the York-led Refugee Research, bringing together Canadian and international scholars in the study of refugee and forced migration issues, and engaging policy makers, non-governmental organizations, and communities of practice in the pursuit of real-world solutions to the needs of refugees and displaced persons: Vision Science To Application (VISTA), York's Canada First Research Excellence Fund program is engaging over a dozen international partner that are key to the impact of the program; the Advanced Disaster and Emergency and Rapid Response Simulation (ADERSIM) program is collaborating with academic institutions and governments internationally to develop preparedness for emergency response and to understand the migration of disease across borders. Similarly, current big science projects involving York researchers, such as Conseil Européen pour la Recherche Nucléaire (CERN), NASA and the European Space Agency, and Brain Research through Advancing Innovative Neurotechnologies (BRAIN), are driven by international research collaboration.

York scholars have achieved the highest standing and recognition in their fields, including over 80 Royal Society and College of New Scholars, Artists and Scientist members, Killam Professors, Humboldt Fellows, Fulbright Scholars, Steacie Medalists, Trudeau Foundation Fellows, Governor General Award winners, and 25 Distinguished Research Professors. York faculty also regularly received prizes and recognition for their work through disciplinary honorifics and prizes for the books, lectures and other scholarly achievements. With a growing allocation of over 35 Canada Research chairs complemented by over 30 York Research Chairs and over 35 Named Chairs and Professorships, and a recently reinforced mechanism to broadly enhance research engagement, York is broadly supporting the research engagement of its faculty across disciplines.

Through York's integrated approach to teaching and research, undergraduate and graduate students, as well as postdoctoral fellows, enjoy the active mentorship of internationally recognized scholars, access to cutting-edge research infrastructure and an exciting and engaged environment for the pursuit of discovery. York hosts one of the largest cohorts of graduate students in the country, and York's graduate students and postdoctoral fellows are key drivers of the University's research excellence and scholarly success. Students and fellows come to York from around the globe and are supported through prestigious national and international research scholarships and fellowships. York is committed to enabling our students to acquire, advance and apply their skills and knowledge and to providing exceptional supervision, engagement and instruction that supports a high quality educational experience.

## Comprehensive Research Engagement across the Institution

When examined through a lens that cuts across disciplines, research strengths where York is bringing national and international leadership clusters across six broad themes:

*Advancing Fundamental **Inquiry** and Critical Knowledge*  
*Analyzing Cultures and Mobilizing Creativity*  
*Building Healthy Lives, Communities **and Environments***  
*Exploring **and Interrogating** the Frontiers of Science and Technology*  
*Forging a Just and **Equitable** World*  
*Integrating Entrepreneurial Innovation and the Public Good*

York is committed to continuing to invest strongly in support of this base of research strength across the institution to enhance the impact and recognition of our scholarship and creative activities.

## Advancing Fundamental Inquiry and Critical Knowledge

- Whether in the humanities, social sciences, fine arts, natural sciences or beyond, pure curiosity-driven research is emphasized across York as foundational to realizing humanity's greatest aspirations.
- Many of the greatest advances in the arts, humanities, social, natural and medical sciences are due to exemplary individual contributions. University-based research must provide ample space for scholars to explore uncharted territory in their areas of expertise.
- The advancement of knowledge entails the examination and critique of existing structures and thinking, as well as the creation of new forms and expressions. Universities must nurture the drivers of innovative and critical ideas.
- We strive for international recognition of ground-breaking research that is contributing to fundamental advance of knowledge.

Discovery of our world provides valuable insights into our potential as human beings. Throughout the university, scholars are investigating the world that surrounds us: from the study of moral, political and legal philosophy to pure mathematics; from investigation of molecular and subatomic interactions to exploring the human brain; from poetic representations of data and generative systems in light and sound installations to the novel use of artificial agents in interactive environments; from the study of the Indigenous life, cultures and traditions to the origins of government, the development of political institutions and non-state systems of government; from the study of chromosomes to the understanding of the cosmos.

The engagement in pure, inquiry-motivated research is a particular privilege for and responsibility of the University's faculty and students. York seeks national and international intellectual leadership as a result of such engagement. The quality and recognition of this foundational research is validated peer review, as well as prizes and awards that recognize the University's work and that provide funding in support of it.

In the social sciences and humanities, a critical approach embraces reflective assessments of society, cultural change and ways of knowing. To advance critical social and cultural theory, researchers are exploring historical change; political activism; the social and economic transformations of societies within Canada and around the world; and how culture has been and continues to be a crucial means of expression and avenue for creative problem solving. York researchers explore a range of moral, political, feminist, indigenous and legal philosophies and ethics, and are expanding the critical analyses of gender, sexuality, age and ability. Across disciplines, the profound dedication to equity is reflected in research devoted to understanding and transforming attitudes towards constructs of race, class, identity, gender and power differentials in a range of social, political, educational and economic formations. Researchers are exploring language acquisition and theories of linguistic variation, change and educational models so that we can understand more clearly the role and impact of language in multicultural societies. By pushing the boundaries of innovative form and expression in the visual and performing arts, researchers probe cultural attitudes towards race, sexual identity and marginalized groups. Through a critical lens,

researchers at York are exploring the impacts and effects of the global movement of people, by displacement or through growing diasporas. They are at the forefront in the study of the effects on society of political, social and cultural inequities, injustices and human rights violations. When we enhance our understanding of world religions, ancient and current cultural practices, and the exigencies of political and economic powers, we can make better sense of a complex world. At the same time, research into the role of archivization in knowledge dissemination and preservation informs the communication of new knowledge. Critical inquiry allows us to hear voices otherwise silenced by historical or contemporary injustice or marginalization.

York displays strong research leadership in discovery science across physics, chemistry, mathematics and biology, psychology and other disciplines. Astrophysics researchers use observations and theory to study the origin and evolution of structure in the Universe, including the role that dark matter plays and how galaxies like our own Milky Way take shape. Using lasers to trap and hold individual atoms, quantum optics researchers are measuring atomic energy states with unprecedented precision, so that even the constancy of fundamental constants can be tested. York's high-energy physicists are bringing leadership to large-scale international initiatives through TRIUMF (Canada's National Laboratory for Particle and Nuclear Physics), the ATLAS collaboration at CERN (the European Organization for Nuclear Research), and the T2K collaboration in Japan that are seeking out and studying the elementary particles of which everything is comprised, including neutrinos, the Higgs boson, and magnetic monopoles. Laser and high-energy physics researchers are seeking to understand antimatter and its role in the Universe, while astrophysics and high-energy physics researchers are working towards explaining the nature of dark matter.

Biological research at York extends from molecules to cells, organisms, populations and ecosystems. York researchers are pushing the boundaries of genomics and proteomics to more fully understand how the expression of genes is regulated and to determine the structure and function of proteins and other factors encoded by the genome. Researchers have developed innovative approaches to investigate the diversity and functionality of the proteome resulting from alternative splicing and post-translation modifications. Physiological, metabolic, behavioural, biochemical and genetic processes are being investigated in different model systems, including yeast, filamentous fungi, insects, fish and mice. Researchers in chemistry and biology are elucidating the structure of molecules and proteins by nuclear magnetic resonance spectroscopy X-ray crystallography and mass spectrometry, and are making seminal contributions to chemical biology, organic, inorganic and physical chemistry, while others are exploring the fundamentals of animal behavior, including migrations patterns and how animals adapt to and interact with their environments.

Pure mathematics is another example of a field where a researcher often proceeds into new territory driven by the desire to probe fundamental theory. Innovative and critical advances in pure mathematics often find application only decades after their conception and in ways never anticipated by their originators.

## Analyzing Cultures and Mobilizing Creativity

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- This theme explores culture and creativity at the intersections of social innovation and tradition.
  - It addresses directly York's diverse and strong expertise in the fine arts, including dance, design, film, music, theatre, creative writing, visual arts and digital arts, as well as a broad spectrum of research in liberal-arts based disciplines that include literature, languages, linguistics, education humanities and social sciences.
  - Research in this area includes a focus on the intersection between indigenous ways of knowing and modern technologies.
  - We are committed achieving a growing the profile and impact of installation, performance and community engagement for our scholarship.
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York University is a major contributor to the advancement of creative work and scholarship in arts and culture in Canada and an emerging global leader in cultural production and creative research. This dynamic creativity is complemented by critical analysis of both culture and cultural production.

The significant breadth and scope of scholarship in communications and cultural studies, fine arts, digital arts and arts-based education, philosophy and environmental studies, languages, literature and linguistics, technical and creative writing, and translation draw together a community of researchers that cut across traditional disciplinary boundaries to facilitate dynamic collaborations. Critical and creative features are mutually informative and often interwoven through scholarly publications and the practice-based production of artists, designers and performers in York's studio programs.

York's research in the areas of culture and creativity influences a range of social, cultural and technological development across sectors and communities. This research draws on internationally leading expertise at the intersection of arts and digital technologies, including digital humanities, education, languages, linguistics, literature and culture. York's researchers are investigating the future of narrative, emerging forms of cultural expression, interactive storytelling, mobile media, gallery installations, and interactive cinema, including 3D cinema and stereography.

Through York's Motion Media Studio @ Cinespace, researchers are driving the development of innovative, cross-platform production for Toronto's film and digital media industry. Researchers are constructing responsive artificial worlds through mixed/hybrid reality technologies, including virtual and augmented reality and are pushing the boundaries of human-computer interaction, in areas including critical technology design and interactive graphics. Artists and designers are exploring new screen technologies, approaches and techniques through production and theoretical study of augmented reality as an emerging medium. Research in these areas depends increasingly on deep learning and other aspects of artificial intelligence (AI) and is complemented and enhanced by AI research conducted in computer engineering, information systems and mathematics. Other researchers across the University are pushing the boundaries of cinema and media studies through exploring the intersections of cinema and media with technology, art and, while York's legal scholars are exploring IP law and policy issues predicted from the next generation of digital technologies.

York's research librarians and archivists are active stewards of the University's research assets and advance our research culture and reputation by providing research leadership in evolving data-driven research methodologies used in the digital humanities. York University Libraries are actively exploring how to better extend this infrastructure into new modes of capturing, organizing and exploiting information and large sets of data and developing new ways to present, visualize and understand this data supporting new forms of cultural expression. This includes curating and digitizing existing archival holdings to better raise their visibility and profile as well as supporting exhibits, communications and digitization with a variety of cultural community partners.

At York, creative cultural production is complemented by the critical study of cultural traditions, cultural production and performance practices including Indigenous narrative and forms of cultural expression and storytelling. Scholars excel in all genres, from the earliest expressions to today's global spectrum of voices. In anthropology, researchers critically explore how people are subjected to, participate in and contest the processes of living in a world that is interconnected by powerful economic, cultural and technological forces. Historical scholars examine the forces and thinking that shaped cultures in the past as a starting point for acting and thinking in the present while the politics of contemporary, popular and more traditional forms of cultural expression are examined from a current political science and communications perspective. Digital storytelling is helping to advance the understanding of Indigenous student achievement and the processes of decolonizing and indigenizing schools. Linguists have been assisting in the development of language policy as it affects public education in Nunavut and are providing insight on its impact and the threats experienced by francophone cultures in Ontario and Quebec, and internationally. In theatre, York researchers have traced the genealogical development of performance studies in Canada and are providing leadership in major international research projects from Bali to South Africa, focused on the history of theatrical design and understanding the traditional narrative of theatre.

Researchers are exploring art, digital media and globalization to better understand how artists in different cities contribute to the development of new cultural and information landscapes. Scholars in this area are documenting new cultural formations and community-based cultures – from urban parks to transitory performances in neighbourhoods to virtual spaces on the Internet. Research outcomes include exhibitions, curatorial interventions, performances and publications. Design researchers imagine new intelligent user interfaces for the future that inform our understanding of communications technology in the world today. Dance researchers are focusing on dance science, including the psychological aspects of injury as well as prevention research, and motor learning and motor control. Additional scholarship focuses on dance history and criticism. York's music scholars are engaging in highly recognized investigations, integrating academic studies and studio training across a wide range of musical cultures and traditions. For example, ethnomusicological research is exploring the lived experience and the ongoing significance of music in defining self and community within a context of global destabilization.

## Building Healthy Lives, Communities and Environments

- This theme encompasses the study of health, from age-related ailments and disease prevention, through cognitive and physical health, to the influence of income inequality, the social determinants of health as well as the health of communities and global health.
- It includes but is not limited to needed changes in health policy, services and systems, as well as research in the biomedical and clinical sciences and population health.
- It speaks to the nature of well-being and the study of how to achieve high-quality, lifelong well-being for individuals and for society, including physical, mental and social well-being.
- We strive for policy impacts and the development of technologies, tools and methods that promote wellness and promote healthy environments.
- The growth and impact of research in this theme also advances York broader ambitions of proactively working towards a medical school that focuses on integrative clinical and preventive medicine, interdisciplinary service delivery and health promotion.

York researchers are focusing on improving health outcomes and bridging new knowledge and applications to improve the understanding, prevention and treatment of disease and injuries and to provide healthier environments for individuals and communities. Initiatives include: biomedical exploration; the study of the social determinants of health and age-related ailments; Indigenous understandings of healthy environments; the promotion of mental, creative and physical health; critical examinations of disabilities; analyses of global health and global health governance; health data mining and management; exploring bullying behaviours; and situating wellness in the contexts of history, culture and the lived environment. This interdisciplinary approach to health research is making a significant contribution towards improving the overall health and well-being of individuals, communities and environments. Researchers at York are exploring the effectiveness of strategies that address health-related inequalities for all people, including those who are marginalized and face increased health risks, with both a national and global view. York's growing reputation as a leader in health research has been reflected since 2017 in the hosting of Canadian Institutes of Health Research's Institute of Population and Public Health.

With support from the Canada First Research Excellence Fund, through VISTA: Vision Science to Application, researchers from across the university are advancing understanding of how the brain works, linking visual neuroscience with computer vision, making connections across the health care sector contributing to new innovations including rehabilitation, neurotechnology, robotics, virtual reality, navigation and other novel interventions based on deep-brain stimulation, image-guided surgery and screening techniques for clinical populations.

In the biomedical sciences, research ranges from bioengineering that is improving medical device technology and improving diagnosis and screening to broad interdisciplinary approaches to improving understanding and treatment of severely debilitating and chronic conditions including diabetes, cancer

autism, Parkinson's, Huntington's and concussion and dementia. Others are exploring critical questions involving muscle health and its contribution to metabolism, mobility and the quality of life and healthy aging. With a focus on promoting wellness and improving quality of life through physical activity diet and memory training, research at York is improving the lives and living of patients.

York scholars are partnering with public organizations and private sector industries to advance mobile personalized healthcare technologies with integrated electronic health records, as well as developing new medical devices and big data platforms, providing health solutions to improve outcomes for patients- all while lowering sector costs. Other partnerships are working to improve vaccine development and delivery and exploring ways improve safety in the health care system through enhancing patient-centered care.

Linking policy to care is a particular strength. Researchers are delivering policy-relevant suggestions around best practices and prevention of emerging health challenges such as disease migration and antibiotic resistance. Through an approach that extends from precise mathematical modelling of disease, to the study of global health governance, social engagement and social justice in overcoming health inequities between the global north and south, researchers at York are contributing to solutions improving global responses to emerging and persistent health challenges and improving the lives of the disadvantaged including persons with disabilities.

Building healthy communities and Environments depends a complex interaction between social, biological, political, behavioural, environmental, economic, cultural and historical factors. Researchers are studying the health implications of homelessness, youth culture and community development within urban settings. They are studying how concepts of health have changed over time and how humans have responded historically to epidemics and other health challenges in a variety of geographical settings. Others are focusing on enhancing literacy and educational involvement and well-being among marginalized populations, including Indigenous peoples.

Researchers are providing a critical voice in the debate over health care reform in Canada. They are addressing privatization, healthy aging, the erosion of universal health care, and inequities in health care. Innovative research on lifelong well-being and work/life balance highlights a comprehensive approach to the study of health that places an emphasis on community engagement, social justice and critical theory. Another area of key research focuses on the contribution of the creative arts to health and social well-being and the balance of health care equity for different groups such as Indigenous communities, women, rural populations, persons with disabilities, economically disadvantaged groups, immigrants and ethnic and cultural minorities, such as an international research initiative led by York researchers is enabling deaf children to develop better societal understanding and more advanced social negotiation skills, leading to more intuitive written skills. We are exploring key issues in global women's health and Indigenous health as part of a larger critical exploration of biomedical knowledge in cultural, social and historic contexts.

Our focus on child and youth research produces leading scholarship on youth homelessness, mental health, education and marginalized youth, relationships and development of infants, children, adolescents and families. Other areas of health-related research include the influences of air and water

quality and atmospheric particulate matter on human health; the association of sustainable growth on individual and population health; the use of biomolecular interactions to diagnose and treat diseases; and women's health, sexuality, including the intersection of LGBTQ sexuality, gender, and human rights.

External partnerships are integral to York's health-focused research. We have local partnerships with industry leaders, regional hospitals, family health teams, public health and the Central LHIN (Local Health Integration Network). Internationally, we have partnerships with organizations in the United States and Western Europe, India, the Middle East, Eastern Europe, China, South America and Africa, sharing with each the mutual goal of helping people live healthier lives and co-creating rejuvenated health systems.

### Exploring and **Interrogating** the Frontiers of Science and Technology

- This theme explores the complexity of science and engineering, technological innovation and the fundamental challenges arising in our global ecosystem.
- The projects in this theme focus on research and development in biology, psychology, chemistry, physics, computer science and engineering and often include industrially relevant discoveries and innovations.
- Disciplines included in this theme are mathematical and information sciences, humanities and social sciences, health sciences, law, environmental studies, and science and technology studies.
- We strive to be at the forefront of scientific discovery and to lead Canadian Universities in technological innovation for the benefit of society.

Researchers work across the sciences and engineering, with a particular emphasis on research that cuts across the disciplines. Researchers in vision research are at the leading edge of developing and applying technology in the areas of computational vision and robotics and are supported in this effort through the VISTA CFREF program. Researchers are integrating the fields of visual psychology, computer vision, robotics and visual neuroscience as they investigate new models of human visual mechanisms and the ways these could lead to visually intelligent machines. York's Advanced Disaster Emergency and Rapid Response Simulation (ADERSIM) is Canada's first academic-industry partnership to address disaster and emergency management at scale, using deep analytics and big data to enhance disaster and emergency planning through leading-edge modeling and simulation technology. Translating big data into actionable discoveries is also the focus of The Big Data Research, Analytics and Information Network Alliance, a diverse network of universities and public and private institutions, led by York researchers to address challenges in big data analytics and visualization. Research in the development of next generation intelligent and interactive systems is bringing together researchers addressing issues with the computation basis of intelligence and mediation between human and computer systems. York's high-powered team of researchers and industry partners are developing end-to-end intelligent systems that involve expertise from computer vision and geomatics to transportation engineering to urban planning. York's Interdisciplinary Digital Media Program is the only research program in the Greater Toronto Area

that combines a rich blend of technology, media and communication that is drawn from the strengths of the computer science, fine arts, cultural studies and social sciences.

York is an international leader in space science research, which provides leadership in collaborations with Canadian, American and European space agencies. Research includes the development and testing of concepts for space flight instruments. Researchers are leading Canada in contributing instruments for international space exploration missions. Ongoing projects include the OSIRIS –REx Laser Altimeter (OLA), a laser terrain mapping instrument that maps the surface of the asteroid, create a 3D model, and guide the spacecraft to a safe landing spot where it will grab a sample to bring back to earth for the NASA mission to the asteroid Bennu. The Canadian Planetary Simulator (CAPS) facility will allow for the simulation and investigation of extreme terrestrial and other planetary environments as well as the development and testing of instruments suited to these environments- the only facility of its kind. York is also supporting the designing, building and operating of instrumentation and payloads for suborbital missions for environmental monitoring. Space Science research includes an emphasis on climate science, including monitoring the atmosphere and sea ice, which complements the University's broad range of environmental monitoring research in air, water, biodiversity, bioanalytical and atmospheric chemistry and geomatics.

Scholars in the humanities and social sciences expand our critical understanding of science and technology by exploring their social, cultural, political, philosophical and material dimensions. This research offers unique interdisciplinary perspectives on both the historical development and contemporary challenges of scientific and technological practices and discourses. Researchers from across the university are collaborating on projects in the development of technologies in the digital arts, computing and engineering. Further, with the development of new technologies come new legal issues and rapidly evolving legal and social norms. York's legal scholars are exploring the complex legal and governance issues surrounding intellectual property, artificial intelligence and technology law, and interacting with their colleagues in sciences and engineering.

In mathematics and statistics, researchers are undertaking leading-edge studies that focus on applications for the sciences and health sciences. They are developing new mathematical models for the prediction of disease transmission and the geo-stimulation of how a disease spreads, and they are coordinating a number of academic-industrial collaborations in data mining, neural networks, pattern recognition and vaccine mathematics, modelling and manufacturing. Significant contributions to this research are being made by researchers in the life sciences, with particular emphasis on biochemistry and molecular biology, cell biology, ecology and population biology, genetics and animal and plant science. Researchers in chemical and physical sciences are pushing the boundaries of nanotechnology and advancing the fields of synthetic chemistry, proteomics and materials science.

## Forging a Just and Equitable World

- Research in this theme extends from understanding the global and international environment to exploring identity, human rights, citizenship and the movement of peoples.
- Research focuses on challenges posed by the social, economic and environmental transitions shaping human activity, focusing on local and international policy making, with an emphasis on environmental sustainability and climate change, urbanization, socio-political systems, the international political economy, history, security, governance, education and law.
- This theme explores public and international affairs and a broader examination of Canadian public institutions and the international environments in which they function, with emphasis on Canada's bilingual heritage, emerging multilingual contexts and Indigenous peoples.
- Research in this theme is providing leadership in policy discussions nationally and internationally surrounding issues of equity, justice and sustainability.

Our leading political, environmental and sustainability research programs are asking critical questions, developing new knowledge and awareness, and challenging existing paradigms. Their findings inform the development of equitable public policy and encourage equitable socio-economic advancement. They are engaged in collaborative international research spanning the social sciences, law, business and engineering. Their research focuses on transnational issues such as globalization, post-colonial criticism, security, gender, human rights and refugees. Their studies also incorporate research related to Indigenous peoples and nations, Indigenous understandings of responsibilities, Indigenous thought, legal scholarship, and language, and highlights York's strength in Canadian and international affairs. Researchers in this area are actively pursuing scholarship that bridges disciplines concerned with the natural and built environments and social justice.

Forging a just and equitable world features scholarship that offers new insights into areas cutting across borders and populations and effectively responding to the challenges shaping human activity and changing the way we live. This includes significant capacity in environmental monitoring research, including oil and gas sector impacts, and a broad spectrum of expertise in air, water and biodiversity monitoring. York researchers are exploring climatic and environmental change in Europe, North America and Asia across various historical periods and showing how this has had profound social, economic and political effects over time.

Through its Sustainability Energy Initiative (SEI), research is leading the development of technologies and policy applications that are advancing sustainable energy solutions. York's researchers lead tool and process development of reducing Canada's overall carbon footprint and advancing sustainable energy sources of the future. This includes advances in materials for green infrastructure, including micro- and nano-structure bio-materials, flexible and light-weight smart polymers. Research in automotive engineering is focused on reducing emissions and on ensuring the next generation of vehicles is safe, durable and fuel efficient.

Further, York researchers are leading the investigation of threats to natural resources and habitats- studying water quality in Canadian lakes; examining the health impact of climate on vector-borne and waterborne diseases; making predictions of climate change by way of insect sub-fossils; monitoring migratory patterns and health of forest songbirds; studying invasive insects; examining the molecular biology of plants; and studying bee biodiversity vital to the pollination of wild plants and crops. Ecologists study the effects of multiple environmental stressors on different ecosystems and develop computer models to predict these effects. These studies advance our understanding of the impact of climate change, acid rain, mineral levels and invading species on the North American landscape and on the biodiversity that is essential to our existence.

Examination of issues related to urban sprawl and political ecology are bridging ecological research and public policy. Researchers are closely examining how non-human agents affect urban societies both in the past and in contemporary global suburban areas. As well, they are conducting studies into worldwide suburban development to examine governance models, land use, immigration, infrastructure and daily life. York's researchers are examining migration and settlement in both suburban settings and urban immigration gateways, looking to improve settlement outcomes in the face of economic, social, political and cultural challenges. Researchers also are exploring issues of cultural citizenship, community and the environment through a range of experimental and creative practices that emphasize public art installations and scholarly publications that examine urban development, Inuit culture and climate change. Ultimately, this research will promote improved understanding of the state of the environment and enhance our knowledge of how to counter the cumulative effects of environmental changes, including the future effects of multiple stressors.

The nature and scale of our societal and environmental problems require the application of a broad spectrum of approaches in seeking solutions in multiple settings. In particular, York researchers are pursuing collaborative, integrative and solution-oriented research on environmental issues in multiple settings and environments. Here, York's EcoCampus within the Las Nubes Biological Reserve in Costa Rica provides a living laboratory where issues of neo-tropical conservation, education and eco-health are studied and explored.

There is considerable scholarship probing important environmental and equity and human rights issues as reflected in Canadian and global environmental law, including those related to Indigenous peoples and the environment. This complemented by research on natural resources law, the impact of resource development on Indigenous treaty rights, ethical investment, governance for sustainability and sustainable finance. Questions of security, sovereignty and jurisdiction are central to equality and the politics of the environment, which are especially relevant to York's Northern and Arctic research, but also apply to other world regions that are experiencing similar pressures and entitlement issues, including culture, ethnicity, gender, sexuality, subnational divisions, civil society, and migration and borders.

York researchers are established world leaders in the inquiry into the origins, nature and consequences of inequalities and oppressions, both individually and at their intersections. These include economic policies of the developed world; the social structures of race, gender and colonialism; and varied physical, intellectual, educational and emotional abilities. Recognizing the pressures often associated

with displacement, migration and the movements of refugees, our researchers are examining the multifaceted dynamics of global migration and the complex issues surrounding refugee experiences. These studies focus on the displacement of populations and individuals across and within borders for reasons of persecution; expulsion; violence; violation of fundamental human rights; and the loss of essential human security and livelihood. York's refugee research is highly collaborative, with strong ties to research centres and organizations around the globe. Within refugee camps, York professors are working to improve the quality of teaching and education for children in the camps by developing mechanisms to deliver post-secondary education to refugees. The outcomes of this work play a strong role in informing public policy development and practice by international, governmental, advocacy and service organizations. Similarly, feminist researchers examine transnational issues and apply a highly interdisciplinary approach to exploring issues of gender, sexuality, employment and labour; health and spirituality; human rights; and equity in education.

International research at York is providing answers to questions on some of the most important and intractable issues around the globe, focusing on issues that are pertinent to understanding Canada and its place on the global stage. This work spans of topics including Canada in the North American and global political economy and the Canadian and international implications of key challenges. In public and international affairs, York's research focuses on analyzing the key challenges in Canadian public life, the Canadian economy, the politics of language and how Canada's public institutions function within domestic and international contexts.

### **Integrating Entrepreneurial Innovation and the Public Good**

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- Innovation relies on the entrepreneurial spirit and courage, but at York its practice and study is animated and framed by principles of social justice and the public good. York is uniquely positioned to meet this multifaceted challenge and bridge these two pursuits.
  - Research under this theme involves disciplines such as business, engineering, ethics and law, corporate social responsibility, corporate governance, sustainable economic development and human rights.
  - This theme is closely linked to "Forging a Just and Equitable World." The development of knowledge and good practices must be tested from the perspective of sustainability.
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York offers a unique professional school environment where research emphasizes technological development and market alignment that is aligned with the increasingly entrepreneurial nature of the university, with entrepreneurship a key driver of many experiential curricular and cocurricular learning activities. This exists within a broader community setting that emphasizes social justice and critical discourse linking to social entrepreneurship for the public good. In particular, our exploration of capitalism, corporatization and business management is balanced by research that questions presumptions of market capitalism, political models, Eurocentrism and bourgeois culture. A number of the world's leading critics of contemporary capitalist society are exploring the violence of capitalist, colonial and patriarchal states, societies and economic systems, and the nature of the structures of governance from the local to the global that instantiate and sustain these violent inequities. While these

two areas may seem more oppositional than compatible, the result is a critical discourse that offers a unique perspective on the development and implementation of innovation that promotes social consciousness and sustainability.

Entrepreneurship has clear ties to a business model for knowledge transfer. Entrepreneurial innovation moves beyond goals driven only by profit motives to the search for ethical ways to conduct develop and conduct business in ways that engage the university. Scholars are researching the reasons that underlie successful entrepreneurship and long-term management and are seeking deeper insights into the dynamics between consumer behaviour and government policy. At the same time, York is recognized as a world leader for our research into corporate social responsibility and for our leadership in responsible business – dedicated to triple-bottom-line thinking that is focused on creating new knowledge about the social, ethical, environmental and political responsibilities of business. This same leadership informs our research into extractive industry practices, the adoption of new technologies including AI, international intellectual property regulation, trade and investment agreements, and corporate governance. Still other initiatives examine labour standards and labour relations and probe how public policy can promote social equality for workers both in Canada and abroad. Research in venture capital, private equity, real estate and infrastructure, and business finance is complemented by research into the cultural, social and economic challenges of human migration, settlement and diasporas. The major emphasis on the development of the “renaissance” engineer, who brings a sense of the public interest and corporate responsibility to professional practice is reflected in the development of research programs that explore transportation networks, energy solutions and development of new devices and technologies, embracing social responsibility and cultural diversity while emphasizing sustainability and a green economy.

York researchers are known for putting critical insight to practical use through dynamic interactions with decision makers in the public and private sectors. From economic policy consultations to gender analysis of budgets, to assessing intellectual property protections and creating informed dialogue on urban transit, we serve as drivers and catalysts for more intelligent public policy. For example, York researchers are helping to frame intellectual property law and related technology discussions in Canada, and they are introducing useful policy options aimed at providing balance in policy- and law-making processes. Our hosting of the Law Commission of Ontario is a further example of our hands-on policy engagement, as is our leadership of the Canadian Observatory for Homelessness and the Refugee Research Network. Our contributions to policy and economics of renewable energy through the Sustainable Energy Initiative are another strong example. A common thread through all of York’s initiatives is our collaborative approach to knowledge creation and social and commercial innovation, in which academic researchers work with community partners, the private sector and policy makers to advance and promote social consciousness and enhance business and economic practices. York researchers exhibit leadership that fosters innovation and enhances society’s capacity building for sustainable livelihoods and supporting the public good.

## **Fostering Individual Success and Investing in Existing Strengths**

York is fully committed to the ongoing development and success of its areas of strength in research, scholarship and creative expression. Indeed, the majority of resources supporting research at York has been and will continue to be devoted to the broadly-based support of excellence in engaged individual and collaborative research and scholarship that forms the basis for the University's recognition as a leading Canadian research institution. The increasing engagement and success of our current researchers, the recruitment of outstanding new researchers and students and expanding cutting-edge research infrastructure, are the primary means through which we achieve our ambitious objectives for the development and recognition of our research, scholarship and associated creative activities. Currently York is recognized as an international leader in over 200 areas of subject prominence, with nearly 35% of our publications in the top 10% of journals worldwide. Within the next five years we expect to increase the scope of our international leadership recognition by at least 10% and make significant progress with respect to rankings across all areas of international prominence

## **Compelling Opportunities for the Strategic Development of Research**

Within the breadth and diversity of cutting-edge scholarship at York are many areas where scholars have coalesced to provide enhanced opportunities for leadership and recognition through strategic investment in more focused collaborative activities. These are complemented by emerging areas of research that are underpinned by a strong vision of the York community achieving new levels of research leadership in ways that bring a unique York perspective to providing answers to some of the world most compelling challenges. Some opportunities are driven by new frontiers of fundamental inquiry, while others reflect the convergence of strong academic interest and external opportunities for translational impact on society. All reflect the ability of York to make a unique contribution. Development of these opportunities brings together varied perspectives, disciplines and understandings that deliver innovative achievements and address emerging challenges. Strategically, by committing to supporting and building these areas of opportunity, we are positioning ourselves to further enhance the profile and recognition of York for its ground-breaking scholarship that informs our academic programming. Some opportunities continue from the past plan with strong progress being complemented by strong continuing opportunity to further enhance our profile and impact. Others are new opportunities, that reflect the progress of scholarship and the evolution of the world around us in areas where York researchers have the potential to excel. Both are approached with foresight and a focus on anticipating the future.

### **Digital Cultures**

The breathtaking pace of digital adoption and expansion underlies most of the technological development of third industrial revolution of the late 20<sup>th</sup> and early 21<sup>st</sup> century. The complexity of penetration and volume of activity continues to accelerate as ever larger data sets and more complex algorithms expand the art of the possible. The expansion of digital has enabled vast new industries and underpins and enables the development and implementation of artificial intelligence. With the

transformation of ways of communicating and of cultural industries, digital has fundamentally disrupted human culture with impacts that are just beginning to be realized. There is both tremendous need and opportunity for research on digital at the intersection of arts and science, pushing technological boundaries, while critically investigating the social and cultural impacts and the ways in which they are shaping and changing human activity and interaction.

Over the past five years, York researchers have driven the development and application of digital technologies through initiatives such as the Motion Media Studio @ Cinespace, VISTA, the Big data Research, Analytics and Information Network (BRAIN). They have also explored how the increasingly digital world is impacting the way we live, interact and do business, creating whole new online cultures and transforming the cultural identities of peoples,

York researchers have been addressing digital from multiple perspectives, from work exploring the impact of digital penetration and possibility in Indigenous communities, to learning how digital gaming can inform education, how digital has changed the concept of ownership, and understanding how personalized digital marketing and digital data analytics are changing business practice. They have also been creating and analyzing big data sets based in immigration documents, creating apps aimed at chronic pain management and the mental health interventions for students, leading critical analyses of the use of the internet to exploit child labour and examining digital considerations of climate change

Over the next five years there is the opportunity for York researchers to grow its national and international profile for its leadership in critically exploring the development and impact of digital activity within a range of cultures. This is an inherently integrative and diverse area of research, supporting new applications, interfaces and content creation, scientific inquiry, design, policy development and critical discourse in digital media. Among the opportunities in this area is guiding the ethical, sociological and technical development of the rapidly expanding capacity in high-performance computing that are associated with the challenges of "big-data" and literacy facing our society today

We will we extend and expand our recognized leadership at the interface of an expanding cluster of creative industries in film, television, informatics, data visualization games and apps development. As well, we continue to accelerate York's profile in major arts organizations and festivals for which we have become well known. Coordinating investment and promoting interdisciplinary interactions will propel research and strengthen industry-academic collaboration. For example, through Sensorium researchers are promoting critical discourse in the digital media art, while in BRAIN they are creating new access to the analysis and visualization of big data. In doing so, we will build on our leading-edge digital arts and technology research and existing collaborations with some of Canada's largest digital media hardware and software companies. Support in this area will leverage York's current success in digital media and encourage continued innovation to drive our leadership forward.

### **Healthy Individuals, Healthy Communities and Global Health**

Never has the health care system in Canada been under greater pressure. Aging and increasingly diverse populations, together with the growing complexity and personalization of health care are driving

the search for health care solutions that emphasize wellness and prevention, to minimize the need for intervention. Increasingly, medical advances are transforming acute conditions such as HIV infection and cancer into long term chronic conditions that must be treated and monitored over decades. The increasing complexity of life and longevity also has been accompanied by increasing challenges to mental health and cognitive function. Providing long term, cost effective solutions to these challenges is an opportunity that aligns directly with the strengths of York's health research, which focuses on wellness and community health and emphasizes York's commitments to equity and social justice.

At the same time health care in Canada remains health care for the privileged. Globally health inequities and challenges affect both far greater numbers and far greater percentages of people in the developing world. In addition to learning how to export and translate health care solutions globally to respond to challenges there is a pressing need to grow the partnership with developing nations to empower global health care solutions and breakdown historically vertical models for their transmission and adoption. In this work, the disciplines of public health (biostatistics, epidemiology, environment, social-behavioural science, health policy and management) intersect with the social sciences (demography, political economy, law and human rights, and sociology) to address problems that can arise locally but have interconnected global implications affecting health and health equity, while always being mindful of underlying cultural, social, legal, environmental and economic perspectives. These issues are further heightened through the large-scale migration of peoples driven by environmental and economic forces and conflict.

Health research has gained considerable momentum and recognition over the past five years both through the individual achievements of researchers and through the successful launch of major initiatives that include: VISTA, bringing together the visual sciences and their application and societal impacts; the Health Care Ecosphere, leading the development and commercialization of personalized health care solutions, and enterprise health technologies that move prevention and management out of traditional environments into new spaces; York University Centre for Aging Research and Education, pursuing active and positive responses to changes and challenges throughout the aging process on a societal and individual level and; The Dahdelah Institute for Global Health Research, pursuing solutions to global health challenges with a focus on women, children, indigenous peoples, prevention and the governance, policy and management systems to fully realize benefits.

Over the next five years we are committed to continuing to grow research that focuses on health, health outcomes and the promotion of wellness. From the biomolecular to the health of populations, from biomedical to social work, and from healthy aging in communities to global child health, researchers will grow their individual success and will fully realize the potential of recently launched initiatives. In addition, we will pursue new partnerships across the health care, social services and global health sectors to extend the leadership and impact of our research. With the opening of a new campus in Markham in 2021, we expect a further enhanced focus on community health, while new directions in bio-engineering research will be launched with the continuing expansion of our engineering programs.

The development of our engaged health research programs is also building the positioning of York, to address Ontario's evolving and unmet clinical and community health needs through a new medical school focusing on integrated interdisciplinary care, family medicine, community health and wellness

through the lifespan. Demographics, healthcare gaps and the evolution of medicine are the drivers behind building a new kind of medical school that places emphasis on the generalist and on the integration of the physician within the context of the broader healthcare and wellness promotion teams. Implementation of a medical school and associated research programs at York will benefit from the tremendous wealth offered by the surrounding disciplines at the University which can provide unique perspectives and innovative approaches to solving some of the most pressing questions in health promotion, disease and injury prevention, and the delivery of healthcare.

### Indigenous Futurities

*“Deeply rooted in history, futurities recognizes that the future, despite its intangibility, is directly impacting us today.”<sup>1</sup>*

In a time when questions about truth, reconciliation and justice are being raised, with continuing deep health, social and societal challenges faced by Indigenous communities in Canada and around the world, there has never been a greater need for research that imagines the future. Research, which draws on Indigenous ways of knowing, ways of being, worldviews and laws, will contribute to changing lives and will have significant impacts on nations, communities and individuals. A recognized global leader in socially engaged research and knowledge mobilization, York’s commitments to engaged community partnerships in research and its pledge to *“facilitate research that is relevant to Indigenous life and respects Indigenous approaches to knowledge and learning”<sup>2</sup>* position researchers to make unique contributions to improving life and lives in Indigenous communities while enhancing cultural, economic and environmental sustainability. Never losing sight of history, this research opportunity simultaneously insists on consideration of our relationships to Indigenous futures and the ways they will continue to influence, shift and impact current research and innovation emphases.

York houses a large group of scholars, both Indigenous and non-Indigenous, whose research exists in relation to Indigeneity, engaging in a range of contexts and of topics from the epistemological to the environmental, from the mathematical to the methodological and necessary interrelations across disciplinary boundaries and borders. Artistic productions and creations that explore Indigenous relationships with Canada, engaging youth in health promotion, legal and environmental interrogation of just and equitable relationships, the interactions between Indigenous and non-indigenous laws, histories of Métis, First Nation, Inuit and Native-American relationships with colonialism, Indigenous language policies, art and education, urban Indigenous education and communities are only a few of the areas York researchers have been actively engaging to date. Most significant, Indigenous researchers have made major contributions to the scholarship of Indigenous ways of knowing. This opportunity will

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<sup>1</sup> Paul Kuttner, 2017, *Futurism, Futurity, and the Importance of the Existential Imagination*. <http://culturalorganizing.org/futurism-futurity/>. Accessed February 11, 2018.

<sup>2</sup> *The Indigenous Framework for York University: A Guide to Action*. 2017. <http://indigenous.yorku.ca/files/2017/08/Indigenous-Framework-for-York-University-A-Guide-to-Action.pdf> Accessed February 11, 2018.

further support and enhance these existing initiatives and foster additional and deeper engagement with these and developing research foci.

Indigenous-related research consistently references community: whether within an urban context, a nation or a global/international community. Indigenous worldview insists that within community all relations matter and being in good relation to all of creation is foundational to healthy communities. As community-based research across a broad spectrum of lands and territories, Indigenous-related research further insists on acknowledging specificity of context. Notions of relationship-building, reciprocity of process and outcome, respectful engagement with each other and relevance of the work to those involved in the projects are integral to the research. This opportunity encompasses post-colonial interests, trans-Indigenous theory, and other community-referenced, reciprocally-beneficial research.

Going forward over the next five years, the focus of this research opportunity will be on Indigenous futurities including social, cultural, artistic, legal policy, economic and justice areas that holistically shape Indigenous experience. Collaboration in exploring Indigenous and non-Indigenous approaches in these areas, while understanding the need for Indigenous researchers to take the lead, will mark the distinctiveness of York's approach. Following this lead holds promise for futures that honour Indigenous ways of knowing and influence the direction of all our work within Indigenous communities, Canada as a nation, and beyond into global contexts. The intent of this opportunity is to ensure that Indigenous-related research includes a commitment to listening to and learning from Indigenous Peoples' knowledge, laws, ecology, spiritual practice and experiences. As researchers participate in imagining the future while never losing sight of the past, our present commitment to the import and role of research in creating the future we desire can only be enhanced.

### **Integration of Artificial Intelligence into Society**

The current rapid evolution of technologies that are promoting the fusion of the physical, digital and biological is being called the fourth industrial revolution. At the heart this revolution is the development of independent decision making capacity, or artificial intelligence (AI), that free devices from dependence on human decision making, extending their functionality and independence from human control. Artificial intelligence is imagined in many forms and involves capacities ranging from visual and auditory perception, reading skill, the ability for accurate autonomous decision making based on existing pre-acquired information and the ability to continuously improve function as additional data and experience is acquired.

AI is predicted as the most disruptive technology ever invented, a technology that when fully adapted will fundamentally transform our economic, social and cultural environments. With our shared focus on equity, social justice and business and technological development and fundamentally interdisciplinary approach to research cutting across from the scientific to the philosophical, York researchers are uniquely positioned to make contributions to the development and implementation of AI technology and to ensuring its equitable and moral adoption to maximize its benefits, while minimizing harm and unintended consequences.

On the scientific and technological side York is leading the development of visual perception technologies, working through VISTA to provide global research leadership at the intersection point between computational and biological vision. Other researchers are working at the cutting edge of autonomous robotics, remote sensing, intelligent information systems and cognitive analytics. On the human side, scholars from across the humanities, social sciences and health are studying the moral and ethical implications of AI adoption, the impacts on governments, labor markets, personal and national security, human health and health systems and the challenges to our individual senses of identity and collective sense of humanity.

The opportunity to be seized over the next five years is for York researchers to become leading intellectual voices in articulating the impacts and consequences of AI on culture and identity, guiding the adoption of AI in a manner that counters the prevalent tendencies towards increasing disparities between rich and poor, have and have nots, working to improve the human condition rather than diminishing it. Success will depend on a strong interdisciplinary approach in which technological innovation is informed by human impacts. Given the scope and scale of the opportunity and the intersection of research and academic programs with increasing training of graduates for the AI workforce, specific directions for research development will be further informed by the recommendations of a collegial AI task force being jointly sponsored in the spring of 2018 by the Offices of the Provost and Vice President Research and Innovation.

### **Public Engagement for a Just and Sustainable World**

As growth in human activity continues, there are ever-greater pressures on our environment and societies from climate change, to the proliferation of disease, to the increasing inequality of peoples and continuing oppression and discrimination. Increasingly, the problems are acute and affecting larger and larger populations. Research in this area is foundational to the values and culture of the university, with researchers across disciplines recognized as world leaders in research of the origins, nature and consequences of inequalities and oppressions, and in addressing the origins and consequences of key environmental and societal challenges. Above all, research in this area strives to impact public policies and the behaviour of governments, public and private organizations and individuals.

The past five years has seen significant growth in individual scholarship in this area, through research provoking the status quo across disciplines. Broadly, scholarship has explored economic policies of the developed world and the social structures of race, gender and colonialism within local and international contexts, and the varied physical, intellectual and emotional abilities that shape and define oppression. Scholars have also been developing workable solutions to environmental challenges related to climate change, population growth, urbanization, industrialization and war, and are deeply committed to addressing the origins, nature and consequences of injustice and issues of inequality, oppression and unfair treatment with a focus on national and international human rights contexts.

Collaboratively, researchers have come together in interdisciplinary teams that are tackling larger issues, from using big data to probe the political and social pressures on the migration of peoples and the challenges faced by refugees, to building a national network exploring relevant solutions for youth

homelessness and child welfare, to studying the evolving nature of work, employment and labour in the global economy, to the coordinated study of urban and suburban futures and associated environmental and public policy, to large scale study of transportation systems, to an exploration of business ethics, corporate social responsibility and sustainability. Researchers are also completing the development of an internationally leading simulation centre for the study of disaster and emergency management in response environmental and human emergencies that will position them at the forefront of best practice solutions and innovation for first response to the growing number of emergencies across sectors.

Building on this base over the next five years, research in this area will address and inform a range of challenges, from emerging issues in urban environments that include governance, planning, land use, infrastructure, economy, security, educational engagement, transportation, energy and quality of life, to responding to natural and manmade disasters including the progressive environmentally driven and acute migration of disease, to working toward the implementation of a national youth homeless strategy, and associated initiatives to improve equity, equality and environments for disadvantaged youth and adults. Additionally, the interaction of individuals and communities with their environments will be a major focus of the new Markham Campus. Dedicated to new ways of engagement, research at this campus will focus on directly engaging the surrounding community and developing and fostering collaborative partnerships with business, social services, secondary and elementary schools.

York is committed to growing our leadership in developing forward-looking solutions towards achieving and equitable and sustainable future.

## **Enabling Strategic Research Success**

Achieving the ambitions articulated in this plan depend on an engaged research environment across the University and resources strategically invested to support research growth and development. This begins with commitments by Units, Faculties and the Institution to research and investments in faculty complement that lead research, scholarship and associated creative activities at the university, and in students and fellows that are the main research engine. Equally important is a strong research support infrastructure, both physical in terms of research facilities, libraries and IT infrastructure, and human, in the form of collegial mentorship, and a dedicated highly competent research support staff.

### **An Operational Plan to Support Research Development**

In 2016, as part of the York's Integrated Institutional Resource Planning Process (IIRP), the office of the Vice President Research led the collegial development of PIER, Plan for the Intensification and enhancement of research<sup>3</sup>. PIER provides an operational framework for growing support of research across the university that is meant to enable the success of the strategic Research Plan in achieving the aspirations of the University Academic Plan. PIER contained 21 recommendations along five thematic categories:

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<sup>3</sup> <http://pier.info.yorku.ca/>

- Growing a Culture of Scholarly Inquiry
- Investing in and Promoting People
- Supporting Research Growth and Development
- Leadership in Research and Research Advocacy
- Building Research for the Future

Expanding participation in research scholarship and associated creative activity and increasing the expectations for engagement is broadly supporting the strategic development of research by building enthusiasm around areas of research strength and opportunity and helping to refocus priorities across the institution in favor of research development. As the forms of scholarship and their outputs have expanded dramatically in the digital age, one key component of building research culture and engagement is being able to fully capture and appreciate the outputs of our work. Increasingly challenging for individuals to fully track, at the institutional level collating research dissemination has become unmanageable. Public and commercial databases offer only partial coverage of classical academic outputs, while alternative metric databases designed to capture broader scholarship are still in their infancy. Additionally, researchers are being asked to communicate their achievements inside and outside the academy in a growing number of formats. To address this issue the Academic Policy, Planning and Research Subcommittee of Senate have requested that the Office of the Vice President Research to begin a collegial exercise to acquire and implement an electronic solution to assist individual researchers and trainees in capturing and organizing their scholarly achievements, as well as to promote institutional and external understanding of the full depth and breadth of research, scholarship and related creative activity at York.

Investing in our researchers is the key enabler of research success and time above all else is recognized as the most valuable commodity. Over the past five years York has accelerated faculty complement renewal and has increased supports for existing faculty as well as new hires. For example, a new more comprehensive research related release program was initiated in 2017 to enhance the amount of time available to faculty to engage in scholarly work. Alongside our growing number of Canada Research Chairs (CRCs) that have been used to build research capacity through external recruitment, York has redeveloped its policies to enable growth of named Chairs and Professorships and have initiated the York Research Chairs (YRC) Program as a recognition and retention tool for current researchers alongside our CRC program. As of July 2018, over 30 York faculty will be supported through the YRC program, including 20 chairs directly supported through the Office of the Vice President Research and Innovation. A recent four-year review of the YRC program reported that the YRC program has increased the visibility and recognition of the commitment to research at York, has enabled both increased researcher success and satisfaction, and is helping to build research leadership across the institutions. Over the next five years, through a variety of mechanisms, most notably including the University's current fundraising campaign, York is committed to continue to growth the supports for our researchers to enable their growing success.

York provides a vigorous environment for our largest cohort of researchers, our graduate students and postdoctoral fellows. We have one of the largest cohorts of graduate students in Canada and a growing number of postdoctoral trainees. Our graduate programs are growing in both numbers and quality, with

an increasing number of trainees supported through prestigious external awards awarded through the Canada Graduate Scholarships program, Tri-Council, MITACs, as well as through many other Canadian and International sources. York also has led Canadian Universities over the past five years in success in the NSERC Collaborative Research and Training Experience Program (CREATE) that provides embedded partnered research experiences to trainees. Likewise, our postdoctoral cohort is also growing in its recognition through national and international fellowship awards.

York also is committed to exposing all undergraduate students to the practice of research and creation by involving them in research projects and the production of artistic works as part of their curriculum, and by going beyond the curriculum to offer internships and other opportunities to participate in and develop research projects over longer periods of time, especially for students considering higher research-intensive degrees.

To support research growth and development there have been substantial investments in research infrastructure over the past five years. New construction at the University in Engineering, Science, the Liberal Arts, Law and Business have emphasized research spaces and research engagement for students and faculty. Planning for the Markham Campus has also emphasized interactive spaces for research and scholarship, with an emphasis on connectivity between researchers across disciplines. These University investments have been accompanied by the success of our researchers in bringing new research equipment and facilities to the University through the Canada Foundation for Innovation, NSERC and the Ontario Research Fund.

One way in which York strategically promotes the development of interdisciplinary research is through our network of Research Centres and Institutes (Organized Research Units: ORUs). These ORUs advance research and research collaboration across the University by providing a home for research development beyond traditional academic units. Steeped in York's tradition of collegial interdisciplinarity, ORUs serve as synergistic hubs for participatory research programs that bring together expertise from across disciplines. At the institutional level, ORUs are expected to align with the demonstrated strengths of York research and our strategic growth opportunities. Similarly, at the faculty level, ORUs are an overt expression of investment in specific research areas. With the current transition to a new activity-based budget model for the university, it is essential that our Research Institutes and Centers continue to enjoy strong Institutional and Faculty supports.

York's investments in research infrastructure will continue, with projects nearing completion in Science, business and Liberal Arts to be followed by new investments in Engineering, Health, Science and other disciplines over the next five years, in addition to the completion of the new Markham campus in 2021.

York's research programs and their outputs must be made available with the fewest possible restrictions. York actively supports accessibility in all areas of research, scholarship and associated creative activity, in particular with respect to scholarly communications and publishing, rights management and knowledge dissemination. Many York researchers provide leadership in the editing and production of nationally and internationally renowned scholarly journals. Over thirty of these journals are hosted directly through York and are freely available.

In working to further grow the international reach and impact of our research, scholarship and related creative activity, we are committed to increase our engagement in international research partnerships and exchanges, and to strongly growing or numbers of international graduate students and postdoctoral fellows. A new eco-campus in the Las Nubes Reserve in Costa Rica is driving research into stabilizing rain forest environments, while York's campus in Hyderabad India is promoting stronger research collaborations with Indian partners, particularly in business and engineering. We are in the process of expanding our infrastructure in support of international research engagement through the development of dedicated resources to support research partnership development and access to international research funding programs. We have also initiated the development of a new International Strategy for York University that will include and integrated focus on research engagement.

### **A Commitment to Working in Partnership, Translating Research into Action and Promoting Innovation and Entrepreneurship**

Research at York is research in respectful partnership with communities, with impacts that improve lives within the communities. York is a global leader in the practice of community engaged research and in maximizing the benefits of that research for communities. Over the past five years York has continued to grow its cohort of scholars engaged in community or socially-partnered research, increased the numbers and depth of partnerships with communities, the not for profit and public sectors, and has extended its leadership in the Social Sciences and Humanities Research Council's flagship Program Partnership Research Grants Program.

At the same time, there has been an accelerated emphasis on the growth of partnerships between York researchers and the private sector, further broadening the engagement of the University and University researchers with the external partners. In part driven by growth of engineering and applied health and natural science, private sector partnerships have grown three-fold over the past five years.

Through individual and conjoint collaboration with partners from the non-profit, public and private sectors, York turns its research into action to benefit local and global citizens. Research partnerships and the transfer of knowledge into communities, the public and private sectors is supported through Innovation York, knowledge mobilization, research commercialization, industrial liaison and entrepreneurship group in the Office of the Vice President Research and Innovation. The rapid growth of Innovation York over the past five years tracks the strong increase in application of the benefits of research from across the academic community, and the development of new university accelerator and entrepreneurship spaces including YSpace, the LaunchYU-BEST Entrepreneurship hub and the new Markham Convergences Centre developed in partnership with IBM and ventureLAB, our regional innovation centre.

The Knowledge Mobilization Unit within Innovation York is Canada's leader, garnering extensive national and international recognition and numerous awards for its work in moving knowledge generated in the Social Sciences, Humanities, Art and Design (SSHAD) into the community and the economy. Industries that rely primarily on the SSHAD disciplines account for almost two-thirds of the Canadian economy. These industries are major agents of positive change within our communities, both in the mainstream and marginalized sectors. York's pan-university knowledge mobilization infrastructure supports multidirectional connections between researchers and research partners, encouraging the development

of knowledge and evidence that informs decisions about public policy and professional practice. Knowledge mobilization advances social innovation through engaged scholarship and assists our partners in the community, government and industry to address society's most persistent social, environmental and economic challenges. Working closely with partners in the community, from NGOs to the United Way York Region to local and international partners in government, York's Knowledge Mobilization Unit is one of the key supports of York's success in community and socially engaged research.

In keeping with our strong commitment to equity and social justice, entrepreneurship at York emphasizes the social and not for profit in addition to the traditional development of for profit enterprises. A social enterprise applies the discipline of business to a persistent unmet social need. A social enterprise can be a non-profit or a for-profit organization, or a blended corporation. Products and services developed by social enterprises can be lucrative, yet social benefits are put before profits and the profits are normally reinvested to further social benefits.

Having strongly invested in entrepreneurship and innovation infrastructure over the past five years and succeeded in growing a healthy and engaged entrepreneurship community in which over 2000 students, faculty and staff engage annually, our goal for the next five years is further double engagement and raise the profile of our achievement and innovation to the level already enjoyed for our knowledge mobilization activities, whose international profile we are also committed to grow further.

### **Summary and Expectations**

Research, scholarship and creative activity are integral to the fabric of York. Their growth and development are amongst the highest priorities for the University. With a strong commitment to quality, academic freedom, social justice and responsibility, York delivers research that advances critical inquiry and scientific discovery, challenges our beliefs and perceptions, and affects the social, cultural and economic development of our country and beyond. This plan reflects York's commitment to research excellence and to the development of new knowledge and creative activities.

Progress against the plan in advancing York as one of Canada's top research universities will be monitored closely and feature an engaged collegial discussion of priorities and milestones. Success will be measured through demonstration of growth in the national and international recognition and impact of our research, scholarship and related creative activity, as measured through the success of our students and fellows, recognition of our faculty for their scholarly achievements, and through our impact on communities and society at large.