

**YORK UNIVERSITY STRATEGIC RESEARCH PLAN:
2018-2023
TOWARDS NEW HEIGHTS**

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Executive Summary

A comprehensive research-intensive institution, York University is home to a proud tradition of scholarship and the pursuit of discovery and innovation. Its commitment to excellence brings together a rich diversity of perspectives with a strong sense of social responsibility that is making a difference to the world around us. Supporting the University's Academic Plan, *Towards New Heights* lays out a vision for accelerating the growth and development of our research, scholarship and creative activity over the next five years that advances York's commitment to research excellence and to the development and application of new knowledge to the benefit of society.

This plan highlights the depth and breadth of research at York – research that is innovative; advances critical inquiry and scientific discovery; challenges our beliefs and perceptions; and affects the social, cultural and economic development of our country and beyond.

York is a leader in research that crosses disciplinary boundaries. This is reflected our research strengths across six intersecting 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

The research, scholarship and creative activity within each theme are informed by disciplines, but are inherently inter- and transdisciplinary in their development and application. These themes reflect areas of research in which we are demonstrating national and international leadership, and are expected to continue to grow and excel over the next five years.

At the same time, there are a select number of more focused areas where we see specific opportunities to further accelerate research growth and success. These five areas of opportunity are timely and address some of the most important challenges that we currently face and are propelling York ahead of the curve in rising to meet newly emerging challenges. They include:

- Digital Cultures
- Healthy Individuals, Healthy Communities and Global Health
- Indigenous Futurities
- Integration of Artificial Intelligence into Society
- Public Engagement for a Just and Sustainable World

Each of these foci transects our areas of thematic strength, bringing in expertise from around the university.

We are committed to a strategic combination of broadly based and focused investments across our areas of strength and opportunity. In five years, we expect to have strongly advanced our reputation and trajectory as an internationally leading, research-intensive, comprehensive Canadian university, making a difference in communities and improving society.

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, diversity 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 our 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 among the University's ambitions. There is a sense of excitement at York surrounding our engagement in critical scholarship — an excitement that is fueled by our growing success and recognition as an internationally leading research intensive comprehensive University emphasizing real-world impacts. From modest beginnings fifty-nine 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 social and societal problems of the 21st century.

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 for researchers 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 that is broadening and deepening York's engagement with and 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 has never been brighter. At the same time, while external supports for research as well as opportunities for engagement and outreach continue to grow, increasing competition and complexity within the Canadian and Ontario post-secondary education system means the challenges facing researchers have never been greater.

York has a strong planning environment and strategic commitment that supports our research base and, at the same time, guides investments in our research strengths and more specific areas of research opportunity to promote individual and collaborative research success. As emphasized in Priority 2 of York's Academic Plan (2015-2020), "Advancing Exploration, Innovation and Achievement in Scholarship,

Research and Related Creative Activities”, continued growth and success in this area is crucial to the overall success of the institution. York’s primary goals of research intensification and recognition are 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 to expanding the success of research at York in ten key areas over the next five years. These commitments include increasing the base of research engagement and scholarly outputs across disciplinary boundaries; increasing external research partnership and community engagement; expanding and enhancing student and postdoctoral trainee engagement; and establishing York as an innovation hub that combines research translation and entrepreneurship with a focus on social justice and building community partnerships.

Similarly, research and innovation feature prominently in York’s Strategic Mandate Agreement, which formalizes ambitions and expectations for York with the Province of Ontario for 2017–2020. Here, the Ontario government describes one of York’s institutional aspirations:

York is a global centre for interdisciplinary and transdisciplinary 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 21st century. (p. 5)

Thus, the importance and prominence of research, scholarship and related creative activities have never been higher at York. This strategic research plan provides the next level of detail in articulating our strategy for translating research ambition into successful outcomes and contributions.

Over the next five years, York is committed to increasing the research participation of full-time faculty and trainees at all levels across the institution, accelerating growth in the number and diversity of our scholarly outputs and research funding base, and expanding the influence of our work through broadening and deepening our external partnerships and engagement in the generation and sharing of knowledge. Our goal is to demonstrate international leadership in scholarship, research and related 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 an academic plan 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 participated in an open and attentive discussion about the role of research, our valuation of research and our aspirations for the future of research at York. With the guidance of an active and dedicated advisory committee that included 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 received through a series of open forums and community consultations on campus and through an active web portal that invited engagement in the planning process. Summaries of what had been said at all events were posted on the site, and feedback was encouraged to be left on 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, by the Academic Policy, Planning and Research Committee of the Senate and by 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 scholarly research in the context of the overall academic mandate of the University. In this plan, these aspirations provide guidance for the growth and development of research at York over the next five years.

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

York strives for the highest academic standards. Our 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 this Strategic Research Plan (2018–2023). It is critical to York's overall success that the 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 into York Region, across Canada and around the world. York's emphasis on interdisciplinarity in our 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. This cultural shift has been inspired 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 important discoveries and influential scholarship of the past half century. They include the discovery of the Higgs boson particle 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 the social and political history of Canada and understanding the environmental changes brought about by colonial expansion on Indigenous societies; advancing understanding of 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; 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 significant global impact. Indeed, over the past five years, 55% of York publications resulting from the collaboration of two or more authors have at least one author from outside of Canada. This leads all Ontario universities. York also has over 200 active research partnerships with international institutions that enables the movement and exchange of researchers and trainees.

Leading examples of the international reach of York's research include the following: the York-led Refugee Research Network is 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 Applications (VISTA), York's Canada First Research Excellence Fund program, is engaging over a dozen international partners that are key to the success 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 the European Organization for Nuclear Research (CERN), NASA and the European Space Agency missions, and the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative – are driven by international research collaboration.

York scholars have achieved the highest recognition in their fields. They include over eighty Royal Society Fellows and twenty-five Distinguished Research Professors. They have been inducted as members of the College of New Scholars, Artists and Scientists and named Killam Professors, Humboldt Fellows, Fulbright Scholars, and Trudeau Foundation Fellows. They have been recognized as Steacie Medalists and Governor General's Award winners and receive a range of disciplinary honorifics and prizes for their books, lectures and other scholarly achievements. York's allocation of thirty-five Canada Research Chairs complemented by over thirty York Research Chairs and over thirty-five named Chairs and Professorships, and a recently reinforced mechanism to broadly enhance faculty research engagement, demonstrates the University's support for 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 them with exceptional supervision, engagement and instruction that supports a high-quality educational experience.

Comprehensive Research Engagement across the Institution

York is providing national and internationally recognized research leadership across six broad intersecting and interdisciplinary 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 ongoing investment that will support these research strengths across the institution, which, in turn, will enhance the influence 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 the fundamental advancement of knowledge.
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Discovery of our world provides valuable insights into its potential and 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 the investigation of molecular and subatomic interactions to exploring the human brain; from the 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 Indigenous life, cultures and traditions to the origins of government, the development of political institutions and the growth of non-state systems of government; from the study of chromosomes to the understanding of the cosmos.

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 through this engagement. The quality and recognition of this foundational research is validated through critical

peer review, as well as prizes and awards that recognize the University's scholarship 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, environmental and legal philosophies and ethics, and are expanding the critical analyses of gender, sexuality, class, race, ethnicity, nationality, citizenship, human-animal interactions, 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, ecological and economic formations.

Researchers are exploring language acquisition and theories of linguistic variation, change and educational models in to help us understand more clearly the role 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 effects of the global movement of people, by displacement or through growing diasporas. York's researchers 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 archives 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-based science across physics, chemistry, pure mathematics, 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 reliability 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 is seeking out and studying the elementary particles of which everything is comprised, including antimatter, neutrinos, the Higgs boson and magnetic monopoles. Applications of this work are not always apparent at the time the work is being done. For example, innovative and critical advances in pure mathematics often find application only decades after their conception and in ways never anticipated by their originators.

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 original contributions to chemical biology, organic, inorganic and physical chemistry, while others are exploring the fundamentals of animal behaviour cognition, including migrations patterns and how animals adapt to and interact with their environments.

Analyzing Cultures and Mobilizing Creativity

- 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, philosophy, 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 strive to expand the profile and recognition of art installations, performance and community engagement through our scholarship.
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York University is a major contributor to the advancement of creative work and scholarship in the 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 the processes of 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 who 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 and through Sensorium, York's Centre for Digital Arts and Technology, 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 they are pushing the boundaries of human-computer interaction in areas that include 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 and art, while York's legal scholars are exploring intellectual property law and policy issues predicted to emerge in the next generation of digital technologies.

York's research librarians and archivists are active stewards of the University's research assets. They advance our research culture and reputation by providing research leadership in evolving data-driven research methodologies used in digital scholarship and in managing research data to maximize accessibility. York University Libraries are actively exploring how to better extend this infrastructure into new modes of capturing, managing and exploiting information and large sets of data, and developing new ways to present, visualize and understand this data to support new forms of cultural expression. This work includes curating and digitizing existing archival holdings to better raise the visibility and profile of these materials as well as supporting exhibits, communications and digitization with a variety of cultural community partners. An evolving and important aspect of this work involves partnerships with Wikimedia to continually leverage emerging online technologies and give better visibility to scholarship and creative works produced by frequently marginalized groups.

At York, creative cultural production is complemented by the critical study of cultural traditions, 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, sociological and communications perspective.

Digital storytelling is helping to advance the understanding of Indigenous student achievement and the processes of decolonizing and indigenizing schools. Linguistics scholars have been assisting in the development of language policy as it affects public education in Nunavut, and they are providing insight into how language policy has led to 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, which are 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 informational landscapes. Scholars in this area are documenting new cultural formations and community-based cultures – from urban parks to transitory performances in neighbourhoods and 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, while other types of scholarship is focusing 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 the 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 physical, mental and social well-being for individuals and communities.
- The growth and impact of research in this theme also advances York's broader ambitions of proactively working towards a medical school that focuses on integrative clinical and preventive medicine, interdisciplinary service delivery and health promotion.
- We strive for policy impacts and the development of technologies, tools and methods that promote wellness and healthy environments.

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; bioethics; 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.

Through VISTA, 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 and contributing to new innovations that include 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 lives and quality of life.

York scholars are partnering with public organizations and private sector industries to advance mobile personalized health care technologies with integrated electronic health records, as well as developing new medical devices and big data platforms and 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 to improve safety in the health care system through enhancing patient-centred care.

Linking policy to care is a special strength of our research. 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 that will improve global responses to emerging and persistent health challenges. Best practices are also improving the lives of the disadvantaged and persons with disabilities.

Building healthy communities and environments depends on 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. 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.

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, nursing shortages 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 groups such as Indigenous communities, women, rural populations, persons with disabilities, economically disadvantaged groups, immigrants and ethnic and cultural minorities. For example, an international research initiative led by York researchers is enabling deaf children to develop better societal understanding and more advanced social negotiation skills, resulting in 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 historical contexts.

Other areas of health-related research include the influences of air and water quality 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 LGBTQ2S 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.
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Research in the sciences and engineering cuts across the disciplines. For example, vision researchers are at the leading edge of developing and applying technology in the areas of biological vision, computational vision and robotics and are supported in this effort through the VISTA Canada First Research Excellence Fund (CFREF) program. They 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 that will 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 modelling and simulation technology. Translating big data into actionable discoveries is also the focus of the BRAIN (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 computational 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, engineering, geomatics and environmental sciences research. Researchers are leading the contribution of scientific instruments for space missions supported by the Canadian, American and European space agencies. The research involves development of space flight instruments, planetary exploration and Earth observation. For example, York is leading the development of a laser terrain mapping instrument that was deployed on NASA's OSIRIS-Rex return-mission spacecraft for the purpose of mapping and collecting asteroid samples from the asteroid Bennu beginning in the summer of in 2018.

York researchers are also leading an engineering experiment involving the tethering of small satellites. The Canadian Planetary Simulation facility has recently been established at the University. It is based on a chamber that is providing extreme environments for planetary science research. York researchers also have an established track record of leadership in atmospheric research with observations to investigate the processes of climate, weather and air quality, as well as broad engagement in the environmental monitoring of air, water and biodiversity.

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 geosimulation of how a disease spreads, and they are coordinating several 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 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, 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.
 - We strive to provide leadership in scholarship impacting policy nationally and internationally, surrounding issues of equity, justice and sustainability.
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Our leading legal, political, environmental and sustainability research scholars 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 and have informed York's Sustainability Strategy (2017). They are engaged in collaborative international research that spans the social sciences, law, business and engineering, and that focuses on

transnational issues such as globalization, post-colonial criticism, human-animal relations, social movements, security, gender, human rights and refugees. Their studies 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 includes scholarship that offers new insights into areas cutting across borders and territories, 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.

The Sustainability Energy Initiative (SEI) is spearheading the development of technologies and policy applications to advance sustainable energy solutions. York's researchers lead tool and process development for reducing Canada's overall carbon footprint and for building sustainable energy sources of the future. This includes efforts in power and renewable energy systems, advancing the development of 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 that the next generation of vehicles is safe, durable and fuel efficient.

York researchers also are studying water quality in Canadian lakes and leading the investigation of threats to these natural resources and habitats; 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 how climate change, acid rain, mineral levels and invasive species threaten the North American landscape and 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.

York researchers are also investigating the ethical implications of climate change and the kinds of responsibilities we have for future generations. Issues of cultural citizenship, community and the environment are being explored by researchers 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. 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. The Reserve's library, La Casita Azul, provides an important link between the campus and the surrounding community through the development of programming and providing study space and internet access.

Considerable scholarship probes important environmental, equity and human rights issues as reflected in Canadian and global environmental law, including those related to Indigenous peoples and the environment. This is complemented by research on natural resources law; the impact of resource development on constitutionally protected Aboriginal rights and 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 initiatives, but also apply to other regions of the world 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 inquiry into the origins, nature and consequences of singular and intersectional forms of inequality and oppression. These include economic policies of the developed world; the social structures of race, gender and colonialism; and inequalities resulting from 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 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 on the part of international, governmental, advocacy and service organizations. Similarly, feminist researchers examine national and transnational issues by applying an interdisciplinary approach to explore issues of gender, sexuality, employment and labour; culture representation and power; 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. In public and international affairs, York's research focuses on analyzing Canada in the North American and global political economy, the Canadian and international implications of key challenges and problems, 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

- Innovation relies on the entrepreneurial spirit and courage, but at York, our practice and study are 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 using an equity lens.
 - We strive to foster innovation that enhances society’s capacity to sustain livelihoods and contribute to economic growth, while supporting the public good.
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York offers a unique professional environment where research emphasizes technological development and market alignment with the increasingly entrepreneurial nature of the University, with entrepreneurship a key driver of many experiential curricular and co-curricular learning activities. This exists within a broader community setting that emphasizes social justice and critical discourse links to social entrepreneurship for the public good. Our exploration of capitalism, corporatization and business management is balanced by research that critically questions the assumptions underpinning market capitalism, neoliberal political models, Eurocentrism and bourgeois culture. Several 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 that instantiate and sustain these violent inequities from the local to the global stage. Rather than being incompatible, these two research areas generate a productive tension that, in turn, yields a unique perspective on the development and implementation of innovation promoting social responsibility and equity.

Entrepreneurship has clear ties to a business model of knowledge transfer, yet entrepreneurial innovation moves beyond goals driven only by the profit motive to search for ethical pathways to develop and conduct business in a manner that engages 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 (CSR) and 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 socio-economic equality for workers both in Canada and abroad. Research about venture capital, private equity, real estate and infrastructure, and business finance is accompanied 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 creation of research programs exploring transportation networks, energy solutions

and the development of new devices and technologies, as well as embracing social responsibility and cultural diversity while emphasizing sustainability and a green economy.

York researchers are known for putting critical insights to practical uses 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 the 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, according to 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 while supporting the public good and contributing to our regional economy.

Fostering Individual Success and Investing in Existing Strengths

York is fully committed to the ongoing development and success of our areas of strength in research, scholarship, and creative expression. Indeed, most of the 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. The increasing engagement and success of our current researchers, the recruitment of outstanding new researchers and students, and the expansion of the cutting-edge research infrastructure are the primary means through which we will achieve the ongoing development and recognition of our research, scholarship and related creative activities. Currently, York is recognized as an international leader in over 200 topic areas, 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 significantly increase our rankings across all topic areas.

Compelling Opportunities for the Strategic Development of Research

Within the breadth and diversity of cutting-edge scholarship at York, there 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 solving some of the world's 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 that can have a transformational effect on society. All reflect the ability of York to make unique contributions.

Development of these opportunities brings together varied perspectives, disciplines and understandings to 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 deepen the recognition of York's ground-breaking scholarship that informs our academic programming. Some opportunities were initiated in our 2013-2018 SRP and have the potential to further enhance the University's profile. Other new opportunities reflect the progress of our scholarship and the evolution of the world around us in areas where York researchers have the potential to excel.

Digital Cultures

The digital revolution that we currently are witnessing is driven by a set of rapid and distinctive technological, economic and socio-cultural developments that began in the late 20th century and continue in the early 21st century. As indicated by the expansion of social media platforms, the expansion of complex algorithms and the exponential growth of data sets, the scope and level of activity of this digital revolution continues to accelerate while its implications are only beginning to be understood. Digital technologies have given rise to vast new industries; enabled the development of various forms of artificial intelligence and machine learning; and transformed means of communication, ways of learning and cultural industries – thereby disrupting notions of culture, society, knowledge and citizenship in highly significant ways. As a result, there is both tremendous need and opportunity for research on the digital world at the intersection of the arts, sciences, law and engineering, pushing technological boundaries while critically investigating the digital revolution's social, cultural and legal impacts and the ways in which it is 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, Sensorium, VISTA and BRAIN, and smart cities technology development. Researchers have also explored how the increasingly digital world is influencing the way we live, interact and conduct business, how it is creating entirely new online cultures and transforming individual and collective socio-cultural identities, and how digital information can help improve our lives from improving services such as first-responder efficiencies to enabling self-driving vehicles.

York researchers have been addressing digital cultures from multiple perspectives. Their work explores intellectual property implications; the impact of digital usage and possibility in Indigenous communities; how digitally based forms of knowledge and expertise are emerging online; how digital gaming can inform education; how digital technologies have changed the concept of ownership; and how personalized digital marketing and digital data analytics are changing business practice. They are creating and analyzing big data sets based on immigration documents; crafting global regulatory strategies to govern big data; creating apps aimed at chronic pain management and 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 to consolidate our national and international leadership in the development of digital 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. One critical opportunity will be guiding the ethical, legal, sociological and technical development of the rapidly expanding capacity of high-performance computing that is associated with the challenges of big data and technical literacy that all societies face today.

We will extend our recognized leadership at the interface of an expanding cluster of creative industries in film, television, informatics, data visualization games and app development. As well, we will continue

to build upon 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 in these areas. For example, through Sensorium, researchers are promoting critical discourse in the digital media art, while through BRAIN, they are creating new access to the analysis and visualization of big data. In doing so, we will build upon our cutting-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 sustain our leadership.

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 neurodegenerative diseases, HIV infection and cancer into long-term chronic conditions that must be treated and monitored over decades. The increasing complexity of life and longevity has been accompanied by increasing challenges to mental health and cognitive function. Providing long-term, cost-effective regulations, technologies and 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 which emphasizes York's commitments to equity and social justice.

At the same time, health care in Canada remains health care for the privileged. In the developing world, health inequities and challenges affect both far greater numbers and far greater percentages of people. In addition to learning how to export and translate health care solutions globally to respond to challenges, there is a pressing need to extend the partnership with developing nations to empower global health care solutions and break down 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), natural sciences (biology biochemistry, bioinformatics) and engineering (biosystems, bioengineering, biomedical devices, microfluidics and bio-micro-electro-mechanical systems) 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 through the individual achievements of researchers and the successful launch of major initiatives. These initiatives 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; creation of the Dahdelah Institute for Global Health Research, whose researchers are 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. Another example of York University's strength in health research is the growth of research and international collaborations across a wide range of bioengineering- and biosystem-related disciplines.

Over the next five years we are committed to expanding research that focuses on health, health care regulations, health outcomes and the promotion of wellness. From the biomolecular engineering to the health of populations, from biomedical to social work and health law, and from healthy aging in communities to global child health, researchers will accelerate 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, natural sciences, engineering and global health sectors to extend the leadership and influence of our research. With the opening of a new campus in Markham, Ontario, in 2021, we expect to further enhance our focus on community engagement, while new directions in bioengineering research will be launched with the continuing expansion of our engineering programs.

The development of our engaged health research programs is expected to build York's ability to address Ontario's evolving and unmet clinical and community health care needs. Over the longer-term York maintains its aspiration for a new kind of medical school to focus on integrated interdisciplinary care, family medicine, community health and wellness through the lifespan. Informed by demographics, health care gaps and the evolution of medicine, our emphasis will be on the integration of the physician within the context of the broader health care and wellness promotion teams. 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 health care delivery.

Indigenous Futurities

Deeply rooted in history, futurities recognizes that the future, despite its intangibility, is directly impacting us today.¹

Indigenous futurity considers how indigenous revivals might be viewed as expressions of "futurity," operating in resistance to those assumptions that consign Native American [Indigenous] peoples and lifeways to the past.²

In a time when truth, reconciliation and justice are dominating public discourse about Indigenous issues and when Indigenous communities in Canada and around the world are facing severe health, social, legal and societal challenges, the need for research that imagines the future has never been greater. Drawing on Indigenous ways of knowing, ways of being, worldviews and laws, futurities research will contribute to changing lives and will significantly affect nations, communities and individuals. As a recognized global leader in socially engaged research and knowledge mobilization, York is committed to building community partnerships in research and pledges to "*facilitate research that is relevant to Indigenous life and respects Indigenous approaches to knowledge and learning.*"³ York's researchers are positioned to collaborate with Indigenous communities on research that will contribute to improving community life while enhancing cultural, economic and environmental sustainability. Never losing sight

¹ Paul Kuttner, "Futurism, Futurity, and the Importance of the Existential Imagination," *Cultural Organizing* (blog), May 17, 2017. Accessed February 11, 2018, <http://culturalorganizing.org/futurism-futurity/>

² Sean Teuton, "Indigenous Futurity," in *Native American Literature: A Very Short Introduction* (New York: Oxford University Press, 2018), chapter 7. Accessed April 20, 2018, <http://www.veryshortintroductions.com/view/10.1093/acrade/9780199944521.001.0001/acrade-9780199944521-chapter-7>

³ York University, *The Indigenous Framework for York University: A Guide to Action* (2017), emphasis added. Accessed February 11, 2018, <http://indigenous.yorku.ca/files/2017/08/Indigenous-Framework-for-York-University-A-Guide-to-Action.pdf>

of history, this research opportunity simultaneously insists on consideration of our relationships to Indigenous futures and the ways they will continue to influence and shift the emphasis in current research and innovation. This constitutes a full acknowledgement that Indigenous peoples are indeed “not vanishing,” in the words of the Menominee poet Chrystos.

York is home to a large group of scholars, both Indigenous and non-Indigenous, whose research exists in relation to Indigeneity. These scholars engage in a range of contexts and topics from the epistemological to the environmental, from the mathematical to the methodological, exploring interrelations across disciplinary boundaries and borders. Recent Indigenous research initiatives are focusing on the artistic productions and creations that explore Indigenous relationships with Canada; the role of youth in health promotion, and the legal and environmental interrogation of just and equitable relationships; the interactions between Indigenous and non-Indigenous laws; the histories of Métis, First Nation, Inuit and Native-American relationships with colonialism; Indigenous language policies, art and education; and urban Indigenous education and communities. Most significant, Indigenous researchers have made major contributions to the scholarship of Indigenous ways of knowing. This opportunity will further support and enhance these existing initiatives and foster deeper engagement with these and other developing research projects.

Indigenous-related research consistently references community: whether within an urban context, a nation or a global/international community. An Indigenous worldview insists that within a community all relations matter and having good relations with all of Creation is foundational to healthy communities. As community-based research, the focus covers a broad spectrum of lands and territories and 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 forward-looking community-referenced, reciprocally beneficial research.

Going forward over the next five years, the focus of this research opportunity will be on Indigenous futurities and will include 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 current research influenced by a future that honours Indigenous ways of knowing and shapes 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 practices and experiences. The commitment of researchers to participate in imagining the future while never losing sight of the past will enhance our commitment to the import and role of research in creating the future we desire.

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 its heart, this revolution is the development of independent decision-making capacity, or artificial intelligence (AI), that frees devices and sensors from dependence on human decision making and extends their functionality and independence beyond 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 are acquired.

AI is predicted as being the most disruptive technology ever invented, a technology that when fully adapted will fundamentally transform our economic, social, legal and cultural environments. With York's shared focus on equity, social justice and business and technological development, and fundamentally interdisciplinary approach to research spanning the scientific to the philosophical, our 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 leadership in research focusing on the intersection of computational and biological vision. On the space exploration frontier, York is the international leader in the development of autonomous technology for cleaning space debris for the sustainable use of outer space for human society, which involves research on spacecraft navigation, control and rendezvous, space robotics and space manufacturing using 3D printing. Other researchers are working at the cutting edge of autonomous robotics, remote sensing, localization, intelligent information systems and cognitive analytics. On the human side, scholars from across the humanities, social sciences, health and law are studying the moral, ethical and legal implications of AI adoption; Also effects on governments, labour markets, the legal system, personal and national security, human health and health systems; and its challenges to our sense of individual identity and collective humanity.

Over the next five years, York researchers will become leading intellectual voices in articulating how AI will affect culture, living, economics and identity. Our work will guide the adoption of AI in a manner that counters the prevalent tendencies of increasing disparities between rich and poor, haves 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 actions. Given the scope and scale of the opportunity and the intersection of research and academic programs that will emerge as greater numbers of graduates are trained for the AI workforce, specific directions and recommendations for research development will be needed. To meet this need, a collegial AI task force will be launched in 2018 and be jointly sponsored 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 and the proliferation of disease, both of which are contributing to increasing inequalities among peoples. These problems are becoming increasingly acute and are affecting larger and larger swaths of the world's populations. Across the University's disciplines, our scholars are recognized as world leaders in research on the origins, nature and consequences of inequality and oppression, the origins and consequences of key environmental and societal challenges, and the changing attitudes towards and treatment of historically disadvantaged groups. Above all, research in this area strives to inform laws and public policies and the behaviour of governments, public and private organizations, and individuals.

The past five years have witnessed significant growth in individual and collaborative scholarship in this area through research that challenges the status quo across disciplines and offers alternatives to it. This scholarship has explored laws, economic policies, socio-cultural worldviews and political structures in the Global North and South; the role of transnational organizations and corporations, histories of subordination and subjugation of humans and nonhuman animals; and the intersecting vectors and

socio-cultural structures of race, gender, sexuality, nationality, ability, and colonialism within local and international settings through which relations of power and systems of domination operate.

Researchers are coming together in interdisciplinary teams to tackle an expanding range of issues: using big data to probe the political and social pressures on the migration of peoples and the challenges faced by refugees; building a national network exploring relevant solutions for youth homelessness and child welfare; studying the evolving nature of work, employment and labour in the global economy; exploring urban and suburban futures, infrastructure and associated environmental and public policy; studying large-scale transportation systems, resilient civil infrastructure and resource management, power systems and renewable energy; and exploring business ethics and 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 to environmental and human emergencies. These studies will position them at the forefront of best-practice solutions and innovations for first response to the growing number of emergencies that are arising from climate change, disease proliferation and human behaviours

Building on this base over the next five years, research in this area will inform and address emerging issues in urban, rural and wilderness environments. These issues include the preservation of ecosystems and species; emission and pollution; human-animal interactions; governance and human rights; planning and land use; infrastructure renewal and creation; the economy; security; educational engagement; transportation, energy and water; and responding to natural and human-made disasters, including the environmentally driven and acute migration of disease. As well, research will inform the implementation of a national youth homelessness strategy; providing engineering solutions for water and energy security and associated initiatives to improve equity; equality and environments for disadvantaged youth and adults.

The interaction of individuals and communities with their environments will be a major focus of the University's new Markham Campus. Research at this campus will focus on directly engaging the surrounding communities and developing and fostering collaborative partnerships with businesses, social services and both secondary and elementary schools.

York is committed to growing our leadership in developing forward-looking solutions towards achieving an equitable and sustainable future-engaging in and developing solutions for issues that matter to Canadians.

Enabling Strategic Research Success

Achieving the ambitions articulated in this plan depend on an engaged research environment across the University and on resources that are strategically invested to support research growth and development. This begins with units, faculties and the institution committing to investments in faculty complement that lead scholarship, research and related 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 in terms of research facilities, libraries and IT infrastructure and in terms of collegial mentorship and a highly competent and dedicated 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 of Research and Innovation led the collegial development of PIER (Plan for the Intensification and Enhancement of Research).⁴ PIER provides an operational framework for research across the University that is meant to enable the success of the Strategic Research Plan in achieving the aspirations of the University's Academic Plan. PIER contains twenty-one recommendations along five thematic categories:

- 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 are 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 favour of research development. As the forms of scholarship and their outputs have expanded dramatically in the digital age, and one key component of building research culture and engagement is being able to fully capture and appreciate the outputs of this work. 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 the Senate has requested that the Office of the Vice-President of Research and Innovation 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 promote institutional and external understanding of the full depth and breadth of scholarship, research and related creative activity at York.

An important aspect of this exercise will be consulting with campus partners to build familiarity with commonly used research metrics, and to develop and promote approaches that better capture the weight and influence of scholarship and creativity produced by York scholars. There are several system-wide and specific institutional metrics and targets that are outlined in York's Strategic Mandate Agreement, which is co-signed by the Province of Ontario and which recognizes and emphasizes York's leadership role in research and innovation. Specific targets include increasing internationally collaborative publications, improving graduate student engagement, expanding student research as well as community-based research and entrepreneurship-supported initiatives. New institutional measures include using more widely the social media and web-based metrics available as these metrics are becoming increasingly important to tracking the success of our research.

⁴ York University, "Working Together to Develop a Plan for the Intensification and Enhancement of Research (PIER)," Plan for the Intensification & Enhancement of Research. Accessed February 11, 2018, <http://pier.info.yorku.ca/>

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 for new hires. For example, a more comprehensive research-related release program was initiated in 2017 to enhance the amount of time available for faculty to engage in scholarly work. Investments in full time faculty complement will continue over the next five years to strategically build research capacity across the institution.

Alongside our Canada Research Chairs (CRC) that have been deployed to assist in building our research capacity through external recruitment, York has redeveloped policies to enable the creation of a greater number of Chairs and Professorships. Thus, the University 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 thirty York faculty will be supported through the YRC program, including twenty chairs directly supported through the Office of the Vice-President of Research and Innovation. A recent four-year review of the YRC program reported that it has increased the visibility and recognition of York's commitment to research, has enabled both increased researcher success and satisfaction and has built research leadership across the institutions. Over the next five years, York is committed to expanding the YRC program and other supports that will foster ever-increasing research success through a variety of mechanisms, including through the University's current fundraising campaign.

York provides a vigorous scholarly environment for our researchers, 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, and an increasing number of our trainees receive support from the Canada Graduate Scholarships program, the Tri-Council and Mitacs fellowships, as well as from many other Canadian and international sources. York has led Canadian universities over the past five years in awards and grants from the NSERC Collaborative Research and Training Experience Program (CREATE), which provides embedded partnered research experiences to trainees. Likewise, our postdoctoral cohort is growing in its recognition through national and international fellowship awards.

York is committed to exposing all undergraduate students to practices of research and creation by involving them in research projects and the production of artistic works as part of their curriculum. As well, York offers internships and other opportunities to participate in and develop research projects over longer periods of time, especially for students considering higher research-intensive degrees. The Undergraduate Research Fair (along with its associated refereed undergraduate journal) and Hackfest are examples of campus initiatives that strive to highlight undergraduate student creativity and research acumen.

York has made substantial investments in the research infrastructure over the past five years. New construction at the University has improved research space for engineering, science, the liberal arts, law and business, which, in turn, has improved student and faculty research engagement. The planning for the Markham Campus has placed emphasis on interactive spaces for research and scholarship, as well as 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. Over the next five years York's investments in our 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 campus in Markham in 2021 and the development of additional partnerships in York Region. the

University is also to ongoing investment in the processes and people needed to support the growing research enterprise, both centrally and within the faculties and units.

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 Centres and Institutes continue to enjoy strong institutional and faculty support.

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, particularly 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 forty of these journals are hosted directly through the York Digital Journals publishing program and are available through various models of open access.

In furthering the growth of the international reach and recognition of our research, scholarship and related creative activity, we are committed to increasing our engagement in international research partnerships and exchanges, and to expanding our numbers of international graduate students and postdoctoral fellows. Our new EcoCampus in the Las Nubes Biological Reserve in Costa Rica is driving research in the stabilization of rain forest environments, while our campus in Hyderabad, India, is promoting stronger research collaborations with Indian partners in business and engineering. We are in the process of expanding our infrastructure to support partnership development with and access to international research funding programs, and we have initiated the development of a new International Strategy for York University that will include an 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 outcomes 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 those communities. Over the past five years York has continued to grow our cohort of scholars engaged in community and socially partnered research, increased the numbers and depth of partnerships with communities, the not-for-profit and public sectors, and extended our leadership in the Social Sciences and Humanities Research Council's flagship Partnership Research Grants Program.

At the same time, an accelerated emphasis on the growth of partnerships between York researchers and the private sector has broadened the engagement of the University and University researchers with external partners. In part driven by growth of engineering and applied health and natural science, private sector partnerships have grown threefold over the past five years. This growth trajectory is expected to continue over the next five years as we work to realize our full partnership potential

Through individual and conjoint collaboration with partners from the non-profit, public and private sectors, York turns our research into action to benefit local and global citizens. Research partnerships and the transfer of knowledge into communities and the public and private sectors are supported through Innovation York, knowledge mobilization, research commercialization, industrial liaison and the entrepreneurship group in the Office of the Vice-President of 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, in both the mainstream and marginalized sectors.

York's pan-university knowledge mobilization infrastructure supports multidirectional connections between researchers and research partners, encouraging the development of evidence that informs decisions about public policy and professional practice. Knowledge mobilization advances social innovation through engaged scholarship and assists our partners in 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, from 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 non-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 as the profits are normally reinvested to further social benefits.

York has invested heavily in the entrepreneurship and innovation infrastructure over the past five years and succeeded in establishing a healthy and engaged entrepreneurship community in which over 2,000 students, faculty and staff engage annually. Our goal for the next five years is to double that engagement and raise the profile of our achievements and innovations to the level already enjoyed by our Knowledge Mobilization Unit.

Summary and Expectations

Research, scholarship and creative activity are integral to the fabric of York. Their growth and development are among the highest priorities for the University. 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, with a strong commitment to quality, academic freedom, social justice and responsibility. This plan reflects York's commitment to research excellence and to the development of new knowledge and creative activities.

Our progress 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 with the University community. Success will be measured through demonstration of growth in national and international recognition of our research, scholarship and related creative activity, as measured through the success of our students and fellows, the recognition of our faculty for their scholarly achievements, and the benefits delivered to communities and society at large.