Driving the Future through Research Excellence

STRATEGIC RESEARCH PLAN, 2020-2025
Ontario Tech University

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Introduction

Ontario Tech University is a small Canadian research-intensive university with seven faculties offering 72 undergraduate programs and 29 graduate programs, a faculty complement of more than 300 members with active research programs, 11 Canada Research Chairs, and hundreds of industry-sponsored dynamic research partnerships. The university excels in nimble, collaborative multidisciplinary research in engineering, natural sciences, computer and computational science, health sciences, business, informational technology, social sciences, and education. The student enrollment is 10,000 undergraduate students and 800 graduate students.

Ontario Tech has, since its founding in 2002, maintained a fundamental commitment to research excellence in answers to basic scientific questions, applied and technological innovation, and societal challenges. The orientation of this research is toward advancing pure scientific knowledge, technological breakthroughs, improving the quality of life and work for all Canadians, strengthening the quality of public services in Ontario, especially in the sectors of health, education and criminal justice, working with industry in the commercialization of our research, collaborating with not-for-profits and community organizations, and contributing to the Canadian economy as well as to regional economic and social development in Durham Region and Northumberland County.

The current COVID-19 pandemic exemplifies the research-intensive strengths of the university and its nimble capacity to be responsive, within days, to the specific research needs of our citizens, health care system, governments, industry, community organizations, and the economy. Researchers from all seven faculties across the university are now engaged in diverse COVID-19 research programs that include seeking basic scientific discovery about the virus and how to prevent its spread, contributing to advanced manufacturing of health care equipment and instruments, providing guidance for mental health and mindfulness, strengthening community resilience, discovering and testing new antibacterial materials, addressing cybersecurity concerns, improving global public health responsiveness, innovating community testing, the role of social media, understanding economic behavior and impacts, implementing new social policy, applying artificial intelligence algorithms, developing innovative ways to teach and learn online, and post-pandemic planning. This collective mobilization by our research community reaffirms the value and importance of our research in a time of immense uncertainty.

Remarkably, in less than two decades, Ontario Tech University has created a vibrant, engaged research community of faculty and graduate students, built world-class research facilities and libraries, established extensive networks of research partners, provided unmatched research opportunities for our undergraduate students, and invested in a supportive, knowledgeable research services staff. This commitment to innovation and research excellence has already yielded important and impactful outcomes in a wide range of fields.

As the university prepares to enter its third decade, it is poised to become a national leader among Canada's smaller research-intensive universities. Ontario Tech University's **Driving the Future with Research Excellence: Strategic Research Plan, 2020-2025** is a strategic guide for the university to achieve this national leadership role in Canada's research community. **Current Research Strengths** identifies six intersecting fields where the university is a research leader at present in 2020. **Strategic Research Priorities for 2020-2025** extends these research strengths, identifying areas and opportunities where the university intends to be a research leader by 2025. **Measuring Our Success** identifies five metrics for judging our progression towards the goal of becoming a national leader among Canada's smaller research-intensive universities.

The Strategic Research Plan was developed in close collaboration with the Research Board of Academic Council during the 2019-2020 academic year. The process involved extensive consultation with the university's research community by engaging individual faculty members at Faculty Council sessions, townhall meetings and an online survey platform. There have also been formal consultations with the President, Provost, Senior Leadership Team, Deans, Administrative Leadership Team, and Academic Council. The 2020-2025 Strategic Research Plan complements, and is in alignment with, the university's new rolling Integrated Academic-Research Plan (IAPR) released in February 2020.

Professor Les Jacobs, PhD, FRSC
Vice-President, Research and Innovation
Ontario Tech University
April 2020

Ontario Tech University Mission

The new 2020-2025 Strategic Research Plan advances Ontario Tech University's core founding **Mission**, which aims to:

Provide superior undergraduate and graduate programs that are technology-enriched and responsive to the needs of students and the evolving workplace.

Conduct research that creates knowledge, solves problems, results in economic and social innovation and engages students.

Facilitate life-long learning that is flexible, inclusive and emphasizes college-university transfers.

Develop academic and research collaborations with industry and community that stimulate and enhance the region and university at home and abroad.

Cultivate a dynamic learning environment for students by promoting social engagement, fostering critical thinking and integrating experiences inside and outside the classroom.

Institutional Priorities

The 2020-2025 Strategic Research Plan is also in alignment with Ontario Tech's **Institutional Priorities**, which are:

Tech with a Conscience

We aim to improve the lives of humans and the planet through the ethical application of technology and innovation. It's a key component in our teaching and learning practices, administrative processes and innovative research projects.

Learning Re-imagined

We adapt to the ever-changing educational landscape by experimenting with the most effective ways to deliver flexible and dynamic learning, giving more choices to more people.

Creating a Sticky Campus

We promote positive social change and encourage an accessible, equitable, diverse and inclusive culture for our campus community.

Partnerships

We help industry, community, government and academic partners be more effective by bringing them together with students and researchers to uncover innovative solutions for our partners' most pressing problems.

Research Values

Our research community embodies a set of core values that inform all of our research activity and provide the points on the compass that guide and motivate our researchers to be:

Inventive: Be entrepreneurial about real world applications.

Imaginative: Be visionary and think creatively about new research pathways.

Inspirational: Inspire the communities where we live, work and play.

Inclusive: Ensure equity, diversity and inclusion underpin all of our research endeavors and our research methods are fair and unbiased.

Integrative: Adopt problem solving methods that combine multiple perspectives and disciplinary approaches, including community-based research method.

Research Code

While academic freedom for researchers is an anchor at Ontario Tech University, we aspire to a code of expectations and professional standards that provides a model for all our research community. The impetus for this code is the fact that the university is embedded within a much broader external ecosystem of research and innovation that is instrumental in ensuring our success. This ecosystem includes other universities in Canada and around the world. Major research and innovation funders including agencies of the Government of Canada and the Government of Ontario provide important investments in research capacity but also set compliance standards and norms. Many of our researchers are also members of professional bodies and associations with their own professional codes of conduct. Our ecosystem also includes industry, community organizations, not-for-profits, local government, and broader public sector organizations that are both collaborators and sponsors of our research as well as agents for knowledge sharing and its commercialization. Ultimately, the principles and commitment that make up our research code reflect not only how we fit into this research and innovation ecosystem but also how our research community distinguishes itself from other research-intensive universities.

Research Excellence
Our researchers strive to produce world-class original scientific research, achieve technological breakthroughs, and improve our understanding of human behavior to ensure a better future.

Equity, Diversity and Inclusion (EDI)
We believe that EDI is integral to achieving research excellence at our university.

Tech with a Conscience
Our research seeks to improve the lives of humans and the planet through an understanding of the ethical, social, and policy effects and implications of innovations and advances in technology, and their potential to enhance human health and well-being.

Truth and Reconciliation
We believe that our research must respect and advance Truth and Reconciliation with indigenous peoples.

Community to National to Global Impact on Resilience, Sustainability and the Economy
We endeavor to deliver research that reflects and directly benefits our local Durham Region and Northumberland County, contributes to the Canadian economy, strengthens environmental sustainability, and supports community resilience, while having a global reach that places our research on the world stage.

Equity, Diversity, and Inclusion

Ontario Tech University champions equity, diversity and inclusion (EDI), recognizing that EDI strengthens the research enterprise and its quality, social relevance and impact. This EDI perspective acknowledges that historically and currently underrepresented individuals experience systemic barriers and biases that disadvantage them in terms of career opportunities and advancement. Ontario Tech recognizes that in order to move beyond superficial responses to EDI and progress towards more substantive changes to the academic and research culture, we must make EDI values and principles central to our institutional mission and have them permeate every area of practice. This commitment is truly embodied in our equity, diversity and inclusion statement:

> *"Innovation begins with the person behind the good idea. Canadians are a vibrant and diverse people, each of whom possesses unique talents, skills, experiences, and perspectives that inspire brilliant ideas. True to the Canadian mosaic, Ontario Tech University fosters an inclusive culture where contributions from all members – including Indigenous Peoples, LGBTQ2+ Persons, Persons with Disabilities, Racialized Persons, and Women – are valued and are given the opportunity to flourish. Ontario Tech is committed to cultivating a diverse and inclusive research community. By refusing to leave talent on the sidelines, Ontario Tech inspires the profound discussions, exceptional creativity, and vanguard thinking that lead to more original, impactful and relevant research results."* (EDI Commitment Statement, **Being Counted and Considered at Ontario Tech University: Canada Research Chair Equity, Diversity and Inclusion Action Plan**, September 27, 2019).

Ontario Tech strives to be an EDI leader among Canadian universities by fundamentally changing the research and academic culture to ensure that individuals from underrepresented groups participate and benefit equitably across the institution. EDI capacity building is key to affecting this cultural change at the university. We have met and are conscientiously working to exceed the current EDI requirements and diversity targets of the Canada Research Chair Secretariat. We were among the first Canadian universities to endorse the Tri-Agency Dimensions Charter on EDI in 2019 and are among the first recipients of a major institutional NSERC EDI Capacity Building Grant. We also strongly supported the signing of the San Francisco Declaration on Research Assessment (DORA) by the presidents of the Canada Foundation for Innovation (CFI), Canadian Institutes of Health Research (CIHR), Natural Sciences and Engineering Research Council of Canada (NSERC), and Social Sciences and Humanities Research Council of Canada (SSHRC).

We recognize that realizing these pledges will not be easy: over the next five years, inspired by the strategic research plan, Ontario Tech University is committed to shepherding and supporting our research community through the implementation of meaningful, measurable and sustainable progress towards embedding EDI in academia and research.

Current Research Strengths

Ontario Tech University is currently a national leader in six intersecting fields of multidisciplinary research that are founded on our dual strengths in basic scientific discovery across disciplines and cutting-edge applications of this research in technological breakthroughs, the health and social sciences, engineering, business, and social innovation. In these fields, our researchers stand out in national and international funding and award competitions, secure extensive industry and not-for-profit organization partnerships and sponsorship, and demonstrate research excellence in scholarly outputs such as journal articles and books. The university has built world-class research facilities and libraries in these multidisciplinary fields that enable our research community to undertake their research programs and that ensure those scholarly outputs are discoverable around the world. The university also provides valuable opportunities for the training of graduate and undergraduate students and other highly qualified personnel such as post-doctoral fellows in these research areas of strength.

Digital Technologies, Machine Learning, and Artificial Intelligence

Situated geographically in Canada's technology hub, Ontario Tech faculty members have developed wide-ranging award-winning research programs spanning multiple disciplines from the natural sciences, computer science, business, education, engineering, health sciences, social sciences, and information technology. These research programs exemplify how both pure research in computer science and applied advanced data analysis utilizing artificial intelligence and machine learning is having a transformative effect on almost every field of scientific discovery and applications. This research strength intersects with our strengths in **Energy, Applied Bioscience, and Environmental Sustainability, Automotive Engineering, Transportation, and Electrification Systems,** and **Advanced Manufacturing and Materials**.

 This research also reflects a core strength that the university has in Information and Communication Technologies (ICT) that facilitates information access and sharing that drives the advancement in a wide range of economic sectors, including 5G broadband communication, cybersecurity, gaming, intelligent energy systems, marketing, smart cities, autonomous transportation, education, neuroscience, and health care. These innovative multidisciplinary research contributions create valuable opportunities for the university to train student talent who go on to employment in diverse sectors of the economy in the GTA and other tech hubs.

Students and post-doctoral fellows from the Graduate Programs of Computer Science, Information Technology Security, Education and Digital Technologies, Electrical and Computer Engineering, Modelling and Computational Science, Health Sciences (Health Informatics stream), Forensic Psychology, Business Analytics and Artificial Intelligence (Proposed), and Computational Finance (Proposed) are key contributors to this research strength as well as the many undergraduate students who have research opportunities through their degree programs. The university now offers a dual PhD program with the University of Technology Sydney (UTS) in Australia.

The university has built an extensive network of laboratories at the Software and Informatics Research Centre (SIRC) where this research is carried out including SAP Next-Gen Labs – Design Thinking, Business Analytics Lab, Hacker Research Laboratory, Advanced Networking and Security Research Laboratory, Laboratory for Games and Media Entertainment Research, Applied User Experience Research Lab for Interactive Media, the Gaming and Virtual Reality Lab, Health Informatics Laboratory, MaxSIM Health, and Finance and Marketing Lab. Other important research facilities include the Cybersecurity Institute, Communications, Signal Processing and Microwave Lab, Digital Culture and Media Lab, Digital Life Institute, STEAM-3D Maker Lab, Education Informatics Lab, Clinical Affective Neuroscience Laboratory, and Visualization for Information Analysis Lab. The university also houses the Joint Research Centre in AI for Health and Wellness with UTS. Five of the university's Canada Research Chairs work in this area.

Areas of Research Strength include: Computational Science; Operations Modelling; Business Transformation; Consumer Behavior; e-Commerce; Marketing; Technology and Pedagogy; Financial Analytics; Drones; Cybersecurity; Risk in the Global Digital Economy; Signal Processing; Digital Immersive Learning Environments; Neuroscience of Mental Health and Substance Abuse; Human-ability Enhancing Technology; Ethics and Equity in Technology Use; Linguistic Information Visualization; Real-time Stream Processing; Computer Vision; Robotics; Augmented and Virtual Reality; Consumer Behavior; Privacy and Trust; Big Data Analytics; Internet of Things; Information & Communication Technologies; User Interface Design; Human Machine Interaction; Digital Learning; Digital Health; Next Generation Networks; Modelling and Games; Business Analytics and AI; Data Visualization and Analytics; Software Development and AI; and STEAM Education.

Energy, Applied Bioscience, and Environmental Sustainability

Ontario Tech is a national leader in research on both energy and environmental sustainability. Our scientists are focused on new basic scientific discoveries and solving fundamental problems in the natural sciences and computer science that will help unlock the potential of clean energy technologies. Our engineers are developing innovative materials and enabling technology that is key to our electrical grid, microgrids, and energy systems in the future. Our researchers are among the best in the world in both nuclear energy and nuclear science including small modular reactors, radiation science, radiation health and safety, simulation research, and nuclear materials management. We also are international research leaders in developing alternative energy sources. Our researchers have made major scholarly contributions to forms of clean energy such as biofuels, hydrogen and fuel cells, geothermal, and solar. We have outstanding capacity in data management and visualization about energy usage. Working with municipalities, we are building complex networks of high-power charging stations for electric vehicles. The university holds a portfolio of patents related to clean energy.

The university has built a strong team of researchers in applied bioscience who use advanced investigational methods in molecular biology, toxicology, chemical biology, synthetic chemistry, physiological studies, epidemiological methods, and computational modelling to advance scientific discovery and develop innovative biotechnology. Our strength in applied bioscience focuses on the capacity for the biosphere and human civilization to coexist, new and emerging biotechnologies, and applications to environmental sustainability. Our scientists study the impacts of disease and human activities, like climate change and resource extraction, on aquatic animals, microorganisms, and livestock. Our social scientists engage critically with environmental governance norms and alternative practices, study how sustainable policies involving access to environmental resources, including clean water and energy, benefit society and the economy, and advance key issues in education around developing resilience, at-risk populations, and technological change.

Students and post-doctoral fellows from the Graduate Programs of Applied Bioscience, Automotive Engineering, Electrical and Computer Engineering, Education, Materials Science, Mechanical Engineering, Nuclear Engineering, and Nuclear Technology are important contributors to this research strength.

The university has world-class facilities where this research is carried out including ACE Climatic Wind Tunnel, Aquatic Research Facility, Clean Energy Research Lab (CERL), Electrochemical Energy Materials Lab, Energy Research Centre, Biomolecular Characterization Facility, Borehole Thermal Energy Storage System, and the Centre for Small Modular Reactors. The university has four Canada Research Chairs and two NSERC Industrial Chairs who focus their research on energy, environmental science, and environmental sustainability.

Areas of Research Strength include: Fuel cells; Renewable Energy; Hydrogen Production & Storage; Clean Technology; Energy Systems; Decommissioning & Site Restoration; Health Physics and Environmental Safety; Computer Modelling; Environmental Monitoring; Fluid-Structure Interaction; Sustainable Development Strategies; Energy Production, Conservation, and Storage; Transportation & Mobility; Nuclear materials management; Biological and Medicinal Chemistry; Biotechnology; Biomaterials; Environmental impacts; Energy and Sustainability Education; Indigenous Governance, Resource Extraction and Free, Prior and Informed Consent; International Environmental Governance; Nuclear energy; Radiation science; Smart grid; Small Modular Reactors; Human Energy; and Environmental remediation.

Community Wellness, Human Performance and Health Promotion

Ontario Tech University has a very strong network of researchers focused on innovative community wellness and human performance promotion research. This also includes work with vulnerable populations that analyzes best practices in community development and urban resilience, and community-engaged research supporting justice-seeking groups, including those with intellectual disabilities, incarcerated youth, Indigenous communities and other vulnerable populations. In collaboration with a cluster of Research Chairs and a dynamic cohort of graduate and undergraduate students, this network is impactful globally in the fields of biomedical and clinical health research, public and population health, kinesiology, psychology, health informatics, health technology, health systems and services. The application of this research promotes the health and wellbeing of those living, working and playing in our local communities as well as guiding decision makers to develop sustainable and healthy global communities that are inclusive and support the physical, social, economic and environmental health needs of global citizenship.

This network includes faculty, students and post-doctoral fellows from the Graduate Programs in Health Sciences, Nursing, Forensic Psychology, Applied Bioscience, Criminology and Social Justice, and Education.

A hub of research labs including the Applied Skill Acquisition in Sport Lab, Clinical Affective Neuroscience Lab, Health Informatics Lab, MaxSim Health Lab, Centre for Applied Nutrition and Cardiovascular Health Research, Human Neurophysiology and Rehabilitation Lab, Neuroimaging and Electroencephalography Lab, Health and Human Performance Lab, Motor Behavior and Physical Activity Lab, Social Research Centre, Centre on Hate, Bias, and Extremism, Occupational Neuromechanics and Ergonomics Lab, Sport Officiating Studies, Centre for Disability Prevention and Rehabilitation, and the Biomolecular Characterization Facility are integral to this research strength. Four of the university's Canada Research Chairs work in this research hub.

Areas of Research Strength include: Exercise Physiology; Emerging Infectious Diseases and Global Health; COVID-19 Related Research; Pandemic Planning; Digital Health Monitoring; Health Informatics; Mental Health & Addiction; Indigenous Child Health; Adapted Physical Activity; Healthy Aging; Epidemiology; Pediatric Health; Community-based healthcare; Laboratory Medicine; Violent Crime Reduction; Disability & Injury Prevention & Rehabilitation; Digital Technology & Learning; Health-Care Simulation; Neuroscience and Motor Control; High-Performance Sports; Skill Acquisition and Motor Learning; Ergonomics & Biomechanics; Implementation Science & Knowledge Translation; Health Policy, Systems and Services; Chronic Disease Prevention & Management; Intellectual & Developmental Disabilities; Therapeutic Drug Design; Community Development; Collaboration with Indigenous Communities; Health Promotion; Mindfulness; Environmental & Occupational Health; Public Health; Dementia; Nutrition; Sleep Science; Social Determinants of Health; Health Equity; Clinical Information Systems; Psychiatric Vulnerabilities; Educational Accessibility; Poverty Reduction; Healthy Aging; and the Discovery of Novel Therapeutics to Treat Disease.

Automotive Engineering, Transportation, and Electrification Systems

Positioned in the automotive manufacturing heartland of southern Ontario, the university has built world-class research facilities including most notably the General Motors Automotive Centre of Excellence (ACE) climatic wind tunnel that has positioned its researchers to be both leaders in automotive research and pioneers in new mobility systems including the next generation of cars, buses, trains, drones, and even e-bikes. ACE is one of the universities core research facilities accessible to our entire research community. Our automotive engineering research and close industry collaboration is especially innovative in its recent contributions to vehicle dynamics and control, advanced powertrains, and aeroacoustics. As the research hub for the Autonomous Vehicle Innovation Network (AVIN) focused on human interactions with electric and self-driving vehicles, our industry partners include the leading Silicon Valley automotive original equipment manufacturers (OEM). The talent pipeline in automotive tech from Ontario Tech University combined with its globally leading full scale Autonomous and Electric Vehicle testing infrastructure has made Durham Region one of the world's strongest innovation environments for companies disrupting the automotive marketplace.

Students and post-doctoral fellows from the Graduate Programs of Automotive Engineering, Computer Science, Electrical and Computer Engineering, Information Technology Security, Materials Science, and Mechanical Engineering are important contributors to this research strength.

World-class facilities supporting our research in mobility and electrification systems include ACE Climatic Wind Tunnel, Clean Energy Research Lab (CERL), Software and Informatics Research Centre (SIRC), and the Energy Research Centre. The research community includes five Research Chairs engaged in this field of research.

Areas of Research Strength include: Battery Charge & Storage; Assistive Mobility Devices; Intelligent Mobile Systems; Autonomous Vehicles; Vulnerable Road Users; Cybersecurity; Assistive Technologies for Learning Different; Mobility & Software Testing; Climatic & Environmental Testing; Electrification of Transportation Systems; Automotive Dynamics & Control; Vehicle Thermal Aerodynamics & Thermal Management; Automotive Structure & Chassis Design; Transit Modelling & Optimization; Wireless Communication Technologies; Data Ingestion, Analysis & Visualization; Automotive LIDAR & Radar; Precipitation Characterization; and V2X Communication.

Advanced Manufacturing and Materials

Working collaborative with our extensive network of industry partners, researchers at Ontario Tech University are recognized leaders in manufacturing engineering as well as the synthesis and characterization of materials. Applications of this award-winning research have led to the development of sustainable and environmentally friendly approaches and techniques for manufacturing processes, product development and energy systems. This multidisciplinary research involving both scientists and engineers is transforming manufacturing processes in a range of sectors of the economy in Canada and abroad.

Students from the Graduate Programs of Applied Bioscience, Automotive Engineering, Computer Science, Electrical and Computer Engineering, Materials Science, Mechanical Engineering, and Modelling and Computational Science are important contributors to this research strength.

Key research facilities that support intelligent manufacturing and materials research at Ontario Tech University include the Advanced Digital Manufacturing, Electrochemical Energy Materials Lab, Automotive Centre of Excellence (ACE), Materials Characterization Centre (MCC), Advanced Digital Metrology, and Mechatronic and Robotic Systems Laboratory.

Areas of Research Strength include: Fuel Cells & Electrochemistry; Corrosion Resistant Coating; Nanotechnology; Surface Science; Electronic Materials; Mechatronics & Automation; Advanced Robotics; 3D Printing; Next Generation Genomics; Sustainable Processes; Climatic & Environmental Testing; Software Testing & Simulations; Data Storage & Visualization; and Noise & Vibration Control.

Crime, Justice, and Forensics Sciences

Ontario Tech University has established a distinctive national research reputation in the field intersecting forensic psychology, criminology, and forensic science. Anchored by three top-ranked PhD programs, our professors and their graduate students are making impactful research contributions that strengthen the justice system in Canada. Our undergraduate and graduate programs are training highly qualified personnel for industry, government, universities and colleges, and the broader public sector.

Our top ranked graduate programs that support this research strength includes Applied Bioscience (Forensic Bioscience Stream), Criminology and Social Justice, Education and Digital Technologies, Forensic Psychology, Information Technology Security, Materials Science, Social Practice and Innovation (proposed), and Police Leadership, Corrections and Public Safety (proposed).

The unique university research facilities that support this cluster of researchers include Canada's first Crime Scene House as well as Applied Law Enforcement Research & Training Laboratory, Centre on Hate, Bias, and Extremism, Crime, Clinical Affective Neuroscience Laboratory for Discovery and Innovation, Development, Context and Communication Lab, Entomology Lab, and Forensic Materials Laboratory.

Areas of Research Strength include: Hate Crime; Vulnerable Populations; Child Testimony; Wrongful Conviction; Human Trafficking; Cybercrime; Policing; Investigation Techniques; Law & Community Engagement; Bias in the Justice System; Prosecution and Trial Procedures; Racial Profiling; Anti-Social Personality Disorders; Technology & Pedagogy; Bullying; Emotional Robotics; Technology & Crime Prevention; Law & Social Change; Critical Criminology; Online Privacy; Detection of Deception; Geographical Profiling; Sexual Violence; Psychopathy; and Body Decomposition.

Strategic Research Priorities For 2020-2025

Ontario Tech University is strongly committed to providing the research infrastructure and services that are necessary for all members of our research community to strive for excellence in their research programs. Key components of this commitment include having state-of-the-art research facilities, strengthening the internal information technology supports for research, integrating our researchers into regional and national high performance computing and data networks, enabling access to student research assistants, offering research leave and research chair opportunities, and providing research services that guide and support researchers with the submission of funding applications, compliance with research ethics, and financial accountability. The university is also committed to increasing investment in on-campus Core Research Facilities (CRF), which are facilities and equipment accessible to all of our researchers. Ontario Tech also recognizes the value and importance of providing strong funding support for our graduate students across the university. Sustaining and extending our research infrastructure and services, including fulfilling our EDI commitment statement, is the highest strategic priority for the university in its goal to become a national leader among Canada's smaller research-intensive universities.

The university has set six specific strategic research priority areas where we aspire to be research leaders by 2025. These priority areas, which build on and extend our current research strengths, are a reflection of both the major anticipated research funding opportunities – provincially, nationally, and internationally – that will be available to our research community over the next five years, and the research and commercialization needs of our diverse set of partners – industry, community organizations, the not-for-profit sector, and governments.

Data Science, Artificial Intelligence, and New Technologies

New and original pure research in computational science and computer research drives technological innovation around the globe. This pure research remains a fundamental priority at Ontario Tech University. Novel integrated technological advances that build on this research are driving economic prosperity, security, and social fairness. The use of advanced data analytic techniques including machine learning are revolutionizing diverse sectors of the economy ranging from cybersecurity and gaming to public education and health applications to software testing and industry that are creating demands for innovative applications of data science. Enabling technologies such as micro-and nano-electronics, nanotechnology, and photonics, and immersive technologies such as digital simulations and virtual reality present new opportunities for impactful **Tech with a Conscience** research.

• We will prioritize research that focuses on the use of advanced data science techniques, including machine learning and visualization, particularly in applications that can advance our utilization of 'Big Data' analytics, to achieve positive outcomes for society. Developing further the university's world class strength in cybersecurity and gaming including supporting the new Cybersecurity Institute is a key priority area.

• We will continue to prioritize researching innovative technology-enhanced pedagogy and learning experiences that disrupt traditional educational expectations regarding achievement, accessibility, and skills-development from early childhood education and elementary schooling to high school and post-secondary education and finally to life-long learning. Simulation and other immersive technologies are important strengths among our researchers.

• Although theoretical research on quantum computing is decades old, possible business and industry applications are only now emerging as real-world quantum computers with the technical capabilities to utilize Artificial Intelligence are coming online. An important strategic priority for Ontario Tech is developing research capacity on hybrid applications of quantum and high-performance computing that can be used by business and industry.

Canada's Energy and Environmental Future

The vision for a zero-carbon economy is one of the most ambitious and disruptive national goals Canada has ever embraced, in large part because it requires new thinking that reaches beyond research silos and integrates advances in the natural sciences and engineering, computer and computational science, business and the digital economy, and the health and social sciences. This vision also requires respectful consultation with Indigenous Peoples. Ontario Tech University, with its immense strength in energy, applied bioscience, environmental sustainability, community wellness, information and communication technology, and business information technology, is uniquely positioned to help shape the research agenda on Canada's Energy and Environmental Future and the role of disruptive technology in the realization of that vision.

- We will be focused on developing our research and policy capacity through new initiatives such as the Brilliant Energy Institute and the Centre for Small Modular Reactors as well as existing strengths at Clean Energy Research Lab (CERL). We are also committed to investing in developing the Biomolecular Characterization Facility as a Core Research Facility with equipment and resources accessible to researchers across the university.

- We will explore major new biotechnology and sustainability-focused research partnerships such as the EARTH District with other universities, community organizations, and First Nations and Indigenous organizations in the region.

- We will seize new funding opportunities that will support our researchers to address the complex challenges that are involved in the transition to a net-zero carbon economy, across disciplines from bioscience and physics to engineering and data science to education and social sciences.

Healthy Populations, Community Well-Being and Social Justice

Ontario Tech University is strongly committed to investing in our research capacity in the health and human sciences, including supporting our growing number of national and international collaborations in these fields. We are placing a special priority on COVID-19 related research. Recognizing that the health and well-being of Canadians is directly impacted by our research, we will continue to prioritize both pure and applied scientific discovery focused on human health and well-being, and biomedical research. Reflecting our institutional commitment to Equity, Diversity, and Inclusion (EDI), this positioning offers to the university an opportunity for research synergies that will strengthen further our contributions to global public health, health promotion and improving human performance. These synergies will integrate faculty members and students from across the university, including health scientists, psychologists, social scientists, and data scientists.

- Biopsychosocial research in the area of human movement including sleep, sedentary time, physical activity, brain-body interactions, ergonomics and sport is essential for maintaining and improving health and performance of all Canadians, across the lifespan and across the spectrum of skill and ability. This research will be bolstered through state-of-the-art laboratories, strong partnerships, and trainee support, and will be applied across healthcare, community, and high-performance sport settings. We will also prioritize evidence-based research focused on improving human performance and reducing maladaptive behaviors in order to promote best practices in training and procedures in applied settings within law, business, government, and education.

- We prioritize public health and clinical research to support the health and wellness of populations, communities and individuals impact the understanding and application of the determinants of health, health education, health policy, health interventions, and health services. This research has applications from the local to global level. The use of technology in addressing health care access and delivery is important at the public, patient and provider level.

- We will intensify ongoing research on the twin imperatives of population health and community well-being with an explicit focus on the pursuit of social justice. We will provide useful data on, and conduct helpful analyses of, social determinants including poverty, access to education and legal services, environmental degradation, social isolation, and other factors. We will expand our collaboration with the non-profit sector and social justice advocacy groups, and share research results with relevant public sector actors to help inform evidence-based decision making and policy implementation.

- We will also prioritize building a network of comprehensive research partnerships and affiliation agreements with surrounding hospitals, other health care service providers, health promotion, recreation and leisure providers, local industries and employers, as well as national/provincial/local health and sport organizations that will facilitate rapid knowledge translation and mobilization, enable the sharing of academic staff, and the submission of joint funding applications to support collaborative research on pressing public health issues such as emerging infectious diseases and pandemic planning.

Autonomous Vehicles and Systems

Robotics, mechatronics, and autonomous systems are playing an ever-increasing role in the world of tomorrow: from autonomous vehicles, to home assistant robots, to unmanned aerial vehicles. Ontario Tech's research strengths enable it to be at the forefront of this interdisciplinary research area while at the same time contributing to Canada's capacity for advanced and intelligence manufacturing. Building on our unique research capacities at ACE including the new moving ground plane, our current strengths in **Automotive Engineering, Transportation and Electrification Systems,** and **Digital Technologies, Machine Learning, and Artificial Intelligence** have enabled the University to become a research hub in future-looking autonomous/electric vehicles and systems, including embedded software, real-time systems, and safety-critical software systems, while building on the historic role that the region has had in the automotive sector.

- We are positioned to be nimble and adaptive to new opportunities with automotive Original Equipment Manufacturers (OEM) as well as in other emerging sectors such as aerospace and defense.

- Our strengths in fields such as robotics, sensors, thermal aerodynamics, embedded software, safety-critical software systems, and electrification are at the cutting edge of where research on autonomous vehicles and systems is heading.

- We see the university as the research and talent anchor for the development of a manufacturing hub and supply chain in the region for autonomous vehicles and systems.

Intelligent Manufacturing and Materials Innovation

In the current climate of global economic uncertainty, restoring and extending Canada's manufacturing capacity is key to securing the country's economic future. Considering its geographic location and research potential, Ontario Tech prioritizes supporting the next generation of manufacturing as a Canadian supercluster in innovation, science and economic development. Research at Ontario Tech University has always positioned itself as an important contributor to the advanced manufacturing space. Disruptive and emerging technologies are creating new opportunities to expand these contributions. The integration of intelligent and autonomous technologies that utilize artificial intelligence and machine learning for advanced manufacturing is a research priority for the university, allowing us to build on current research strengths to establish ourselves as a leader in manufacturing and materials innovation. This is a response to the forecasted demands from the industries in moving towards the objectives of Industry 4.0, the latest revolution in industrial manufacturing.

- We will expand and grow the Materials Characterization Centre, an existing Core Research Facility where industry and academic research teams from across the university collaborate and develop innovative materials with real world applications.

- We will expand our capacities in manufacturing process modeling, precision manufacturing, intelligent inspection, control and diagnostics, embedded software, and their corresponding cyber-physical components aligned with the requirement of Industry 4.0.

- We will build on our strengths in polymers and nanotechnology to extend the applications of this innovative research to new sectors of industry including bioengineering, filtration, sensing, energy harvesting and noise mitigation.

- We will develop new capacity in the hybrid application of quantum and high-performance computing in intelligent product design, manufacturing, data collection, and cybersecurity.

Social Innovation, Disruptive Technologies, and the New Economy

Disruptive technologies have played an important part in the creation of the new economy, characterized by precarious employment, vulnerable populations, growing income inequality, mental health crises, dysfunctions in the criminal justice system, and social exclusion. The research strengths in business and the social sciences have enabled the university to become a hub of social innovation and critical inquiry into this new economy. Volatility and uncertainty in global health security, local communities and economic markets create ever more pressing need to address the social and EDI impact and dimensions of these changes.

- We will continue to support the expansion of our recently established research centers engaged in this work (Digital Life Institute and Centre on Hate, Bias, and Extremism) to pursue research across demographic groups seeking social and environmental justice, equity, and systemic change.

- We will continue to support diverse funding opportunities for critical research into the nature and impact of social and technological change on the criminal justice system, education, consumer behavior and marketing, business, social and political structures, and diverse communities, including Indigenous Communities.

- We will capitalize on and develop new business, not-for-profit sector and industry partners to better understand and address how social innovation can help us to deal with changing economic and labour markets and growing instabilities within social and economic power structures.

Measuring our Success

The **Strategic Research Plan, 2020-2025** is instrumental for Ontario Tech University to become a national leader among Canada's smaller research-intensive universities. Driven by the pursuit of research excellence, our research community set out on this path in 2002 and we aim to realize this goal by 2025. Our success will be measured by five objectives:

Intensify Research Capacity Through Partnerships
We will have advanced this objective if we have:

- Significantly increased the number of multidisciplinary research partnerships we have with industry, public sector, not-for-profits, and community organizations.

- Extensively broadened the opportunities for our researchers to share and commercialize their research in collaboration with our industry partners.

Strengthen Research Excellence Reputation Nationally and Internationally
We will have advanced this objective if we have:

- Improved our overall ranking to be among the top 35 research universities in Canada and among the top 25 universities in terms of research-intensity.

- Increased the major awards and honours received by our researchers in recognition of their excellent research contributions and scholarship.

Optimize the Matching of Research Strengths to Opportunities
We will have advanced this objective if we have:

- Establish new Core Research Facilities (CRF), research institutes, centres, and chairs that consolidate and showcase our research strengths in the education, engineering, health sciences, information technology, social sciences, and the natural sciences.

- Expanded significantly the size and research strength of our graduate student and post-doctoral fellow community while at the same time preserving our status as a national leader in providing research opportunities for our undergraduate students.

Sharpen the positive impact of our research, regionally and nationally, on economic and social development as well as environmental sustainability

We will have advanced this objective if we have:

- Made demonstrable and highly visible contributions to Durham Region and Northumberland County by providing new economic opportunities and improving the quality of life of people living in the region.

- Increased the opportunities our undergraduate and graduate students have to be directly involved in conducting research with local and national industry and community partners.

Integrate Equity, Diversity, and Inclusion (EDI) into all of our research activities and practices

We will have advanced this objective if we have:

- Shepherded and supported our research community through the implementation of meaningful, measurable and sustainable progress towards embedding EDI in academia and research.

- Taken a national leadership role as one of Canada's smaller research-intensive universities in the integration of EDI into our research enterprise.

REPORTING ON OUR PROGRESS

Annually, the Vice-President, Research and Innovation will provide a report card to Academic Council and the Board of Governors on the progress we have made in meeting these five objectives as well as our successes in the Current Research Strengths and the Strategic Research Priorities. This report card will be designed to integrate fully traditional research assessment metrics with newer ways to assess research excellence so that this reporting exercise is a reflection of our strong commitment to Equity, Diversity, and Inclusion. It will also identify areas of concern that require improvement.