



STRATEGIC RESEARCH PLAN

“Building on a Solid Foundation”

Prepared for

CFI and the Tri-Council Chair Secretariat

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Acronyms

ACE	Automotive Centre of Excellence
AECL	Atomic Energy Canada Limited
AUCC	Association of Universities and Colleges in Canada
CRC	Canada Research Chair
GDP	Gross Domestic Product
GMC	General Motors of Canada
HETRU	Health Education Technologies Research Unit
HQP	Highly Qualified Personnel
NRCan	Natural Resources Canada
NSERC	Natural Sciences and Engineering Research Canada
NWMO	Nuclear Waste Management Organization
OPG	Ontario Power Generation
R&D	Research and Development
S&T	Science and Technology
SRP	Strategic Research Plan
UNENE	University Network of Excellence in Nuclear Engineering

VISION

For the UOIT community to be committed and engaged in research and scholarly activities of national and international standards and with great potential to have an impact on society by addressing socio-economical issues of regional, national and global significance.

OBJECTIVES

Interest is growing in how university research, which is society's largest source of knowledge, affects economic performance. A quantitative study by the Association of Universities and Colleges in Canada (AUCC) confirmed that Canadian university research is a powerful stimulus for economic development, producing measurable increases in GDP and employment. More importantly, university research is shown to exert a dynamic and continuing impact on the underlying productivity of the economy, which carries forward into the future.

UOIT's Strategic Research Plan (SRP) is focused on furthering and strengthening the research and innovation momentum that has been successfully created over the past five years. UOIT will achieve this by closely matching the knowledge creation and training delivered at the university with the advanced technology and skills required by the Canadian economy, and by structuring institutional research priorities in such a way so as to maximize the economic and social benefits of the university's research results to Canada, Ontario and the local region. In this regard, UOIT aspires to:

- (1) Attract top-tier faculty and researchers of national and international reputation;
- (2) Build a sustainable research infrastructure to support faculty to the level necessary to conduct world-class research;
- (3) Maximize research funding opportunities in areas of importance to Canada's economy and social infrastructure;
- (4) Train Highly Qualified Personnel (HQP) by attracting graduate students and postdoctoral fellows, and by engaging our undergraduate students in research activities in an early stage through summer fellowships and research days;
- (5) Create a culture of innovation at UOIT and adopt best practices in knowledge transfer and technology commercialization; and
- (6) Enhance international collaborations with key research institutions and partners worldwide.

RESEARCH THEMES

UOIT has identified five primary research themes:

- I. Community and Social Wellness
- II. Sustainable Energy
- III. Applied Bioscience
- IV. Automotive, Materials and Manufacturing
- V. Information and Communication

All five themes are supported by funding from NSERC, SSHRC, CIHR, CRC, as well as other federal and provincial granting agencies and foundations. Below are the details of each theme.

Theme I: COMMUNITY AND SOCIAL WELLNESS

This theme covers research activities aimed at supporting a national priority for providing means for healthier and safer Canadians under the Federal S&T Enterprise Framework¹. The sub-themes cover research activities across all UOIT Faculties. Several renowned researchers in the area of critical criminology and violence are engaged in research activities worldwide. There is a focus on emerging research issues such as hate crime, counter-terrorism, cybercrime, youth and crime addiction and ecological justice. A research unit specializing in Health Education Technology Research (HETRU) is a focal point of interdisciplinary research engaging faculty members from Education, IT and Health Sciences. The application of technology advanced IT systems, and knowledge transfer in advancing our nation's capacity to deal with social and health problems is one of the niche areas of this group. A second research unit focuses on collaborative research on issues related to community and sustainable urban development. Research activities in Health Informatics are directed by a Canada Research Chair (CRC) in this emerging area of national and international importance.

Sub-themes:

1. Applied Integrative Health Technologies Research
 - a. Advanced Healthcare Technologies
 - b. Health Care Delivery
 - c. Health Informatics

2. Criminology, Crime Detection and Prevention
 - a. Critical Criminology
 - b. Cybercrime
 - c. Inequality and Social Problems
 - d. Public Safety
 - e. Security and Counter Terrorism
 - f. Violence

3. Human Health
 - a. Disease Prevention and Control
 - b. Health Promotion
 - c. Human Biology
 - d. Vulnerable Populations

¹ The Federal Science and Technology Enterprise, presentation by Robert Walker and Wendy Watson-Wright, October 10, 2007

4. Health, Environment and Society
 - a. Community Health and Epidemiology
 - b. Promoting Human Wellness and Quality of Life
 - c. Regulatory Issues and Public Policy
 - d. Social, Medical and Environmental Determinants of Health
 - e. Sustainable Cities
 - f. Technology and its Impact on Society

Theme II: SUSTAINABLE ENERGY

Our society relies on energy that is available when and where it is needed, is generally affordable at stable prices, and can be accessed on a regular basis. For years, the industrialized world has relied heavily on overseas petroleum and fossil fuels supply to meet its energy demands. This situation is no longer sustainable. Moreover, many uses of fossil fuels, as well as the process of extracting them, contribute to air pollution and could cause severe damage to our health and the environment. Through research activities in this area, UOIT faculty and researchers are finding ways to achieve secure and sustainable energy systems by leading transformative change in energy production, conversion and efficiency. By conducting state-of-the-art research in this area, Canada will continue to be a global leader in energy innovation, ensuring that transformational, environmentally responsible energy and transportation technologies are developed for the long-term.

UOIT faculty members are deeply involved in research on present and future aspects of nuclear energy and safety, through their participation on national committees such as the NRCan external advisory panel on Generation IV designs, on fuel and waste management R&D committees, and via externally supported work in collaboration with AECL, NWMO, and OPG. Several research chairs are actively involved in these areas including the UNENE Chair in Health Physics and Environmental Safety, senior and junior research Chairs in nuclear fuels supported by CAMECO Corporation, and a CRC Tier-I in Advanced Energy Systems.

Sub-themes:

1. Alternative energy systems
 - a. Biofuels
 - b. Fuel Cell Systems
 - c. Geothermal and Wind Power
 - d. Hydrogen (mobile and stationary applications)
 - e. Solar and Photovoltaics
2. Energy Efficiency and End Use
 - a. Carbon Capture and Sequestration
 - b. Electrical Power Systems and Power Distribution
 - c. Energy Efficiency, Conservation and Storage
 - d. Energy Systems Integration and Life Cycle Analysis
 - e. Thermal Management and Heat Recovery Systems

3. Nuclear Energy Production
 - a. Advanced Reactor Design and Ancillary Systems
 - b. Non-Electric Applications of Nuclear Energy

4. Nuclear Risk Management
 - a. Aerosols and Dispersion
 - b. Nuclear Security and Counter-Terrorism
 - c. Nuclear Waste Management
 - d. Radiation Detection and Radiation Health Physics
 - e. Safe Operation for Public, Staff and the Environment

Theme III: APPLIED BIOSCIENCE

Life science research today is increasingly interdisciplinary. This trend has been driven in part by a greater reliance on chemical techniques in biological research; indeed, techniques that were once strictly the domain of chemists are now also part of the repertoire of biologists. Given the success and new research opportunities that such approaches have demonstrated, the interdependence of chemistry and biology can only be expected to increase in the future. Understanding at the molecular level has also become increasingly important to produce advances in knowledge and resulting benefits to society.

UOIT research emphasizes a range applied bioscience research from the cellular to the ecosystem level. The environmental science theme focuses on the ecosystem level and the interactions of aquatic systems and of microbial communities with their environments. A Tier I Canada Research Chair in aquatic toxicology is a leader in this interdisciplinary group. Researchers in the Molecular Bioscience and Chemistry theme investigate the interrelated fields of cellular mechanisms of action of drugs and receptors, bioinformatics, and host-microbe interactions. The latter topic includes nutritional immunology through the use of prebiotics and probiotics. Forensic Science, led by a Tier II Canada Research Chair in decomposition chemistry, involves the use of biological and chemical tools to study the decomposition of human remains in grave sites and chemically related aspects of food spoilage, in addition to research in forensic law.

Sub-themes:

1. Environmental Science
 - a. Aquatic Toxicology
 - b. Ecosystem Health and Sustainability
 - c. Environmental Microbiology and Genomics

2. Molecular Biology and Chemistry
 - a. Bioinformatics
 - b. Biological Chemistry and Chemical Biology
 - c. Cell Signaling
 - d. Host-microbe and Plant Microbe Interactions
 - e. Pharmaceutical Chemistry and Novel Drug Therapies

3. Forensic Science
 - a. Decomposition Chemistry
 - b. Forensic Entomology
 - c. Forensic Law
 - d. Forensic Taphonomy

Theme IV: AUTOMOTIVE, MATERIALS & MANUFACTURING

Traditional means of transportation have plagued our cities with traffic congestion, air pollution and unsustainable means of providing long term planning. UOIT, in partnership with GMC and the Province of Ontario, established the Automotive Centre of Excellence (ACE) to be the focal research entity for research into future, more sustainable transportation systems. ACE includes a climatic wind tunnel capable of testing full size vehicles and coaches under normal and simulated adverse weather conditions (e.g., snow, sleet, sub-zero temperatures, or humid conditions, etc.).

This theme focuses on research areas of utmost importance to the Ontario economy. Future transportation systems will require rigorous research efforts in areas such as advanced materials, intelligent systems, batteries and storage and fuel-cell technology, to name just a few. This research is supported by an NSERC-GMC design Chair and a junior Chair in robotics supported by CAMECO Corporation. A CRC Tier-II (pending) is to strengthen UOIT's efforts in the area of robotics and advanced manufacturing.

Sub-themes:

1. Manufacturing Technology
 - a. Control Systems
 - b. Embedded Systems
 - c. Intelligent Sensing
 - d. Robotics and Automation

2. Advanced Materials
 - a. Biomaterials and Polymers
 - b. Micro and Nano Systems
 - c. Materials Performance and Property Prediction
 - d. Surface Science

3. Sustainable Transportation Systems
 - a. Vehicle Thermal Management & Control Systems
 - b. Vehicle Dynamics and Performance
 - c. Hybrid and Alternative Fuel Vehicle Technology
 - d. Aerodynamics and Design
 - e. Flow Traffic Analysis
 - f. Haptics
 - g. Vehicle Noise and Vibration

Theme V: INFORMATION AND COMMUNICATION

The Canadian economy is driven by information flows. This focus has created a predominance of highly sophisticated information users throughout society. Demand for information generates a supply response which leads to information overload. A much clearer understanding of the impact of message streaming through the organization and society is imperative.

Canadians are in transition. There is a significant amount of technology-driven apparatus available; however, it is currently in an overlay mode as opposed to being fully integrated into lifestyles. The impact of technology related to information and communication mechanisms has begun to permeate society. Decisions to work and study simultaneously are heavily influenced by the availability of education programs over the web, similarly the “life-long learning” mantra is reliant upon the availability of such programs. Implications for education policy and future developments in technology assisted learning must be seriously explored. Organizational and societal dependence on information streams will continue to stimulate the need for research, growth and development of all aspects of information systems.

Sub-themes:

1. Communication Systems
 - a. Communication Management
 - b. Inter-cultural Communication
 - c. Media Management
 - d. Organizational Communication
 - e. Wireless Communication and Signal Processing
2. E-learning and Educational Informatics
 - a. Collaborative Online Learning
 - b. Educational Policy Development
 - c. Technology Adoption and Integration
 - d. Ubiquitous Computing in Education
3. Information Systems
 - a. Computer Science

- b. Computational Science and High Performance Computing
 - c. Gaming, Visualization, Virtual Reality
 - d. Management Information Systems
 - e. Modeling and Industrial Mathematics
 - f. Software Engineering and Systems Design
4. Markets and Innovation
- a. Global Markets and Marketing
 - b. Innovation and Entrepreneurship
 - c. Market Efficiency and Evaluation
 - d. Organization Structures

CRC COMPONENT

UOIT currently has five CRCs. Four of these CRCs have been successfully filled in strategic areas such as Advanced Energy Systems, Health Informatics, Decomposition Chemistry and Forensic Science, and Environmental Toxicology. The fifth CRC (Tier II) in Robotics and Advanced Manufacturing has been nominated and pending approval by the Tri-Council Secretariat. Of the filled CRCs, 50% are female. There has been no deviation from the proportion of chairs assigned by each granting agency.

The research conducted by CRCs is of critical importance to UOIT. As a result, UOIT covers the salary costs for all CRCs and all CRC funding (with the exception of a 20% overhead), is available to the chairholders to pursue their research programs. Chairholders are further supported by UOIT's practice of providing protected research time where CRCs receive a 50% reduction in teaching course workload.

UOIT takes the task of allocating CRCs very seriously. In this regard, the Provost's Office has established a procedure to attract the best quality while maintaining transparency and fairness. In summary, after a new allocation of CRCs is announced, the following steps are taken:

1. The Office of the Associate Provost Research initiates a new competition and invites deans of Faculties to submit proposals for CRC candidates (both internal or external);
2. The Associate Provost Research strikes an external review committee of eminent researchers and administrators to review the submissions and rank the candidates based on established criteria of demonstrated excellence;
3. The external committee convenes to deliberate their findings and make recommendations on the ranking of the applicants;
4. The final ranking and the committee's recommendation are shared with the university leadership for their approval; and
5. The successful candidate is notified and invited to complete the nomination documents with close assistance from the Office of Research Services.

Based on its past performance and since its inception in 2003, UOIT has been well positioned to receive and fill all its CRC allocations. If granted additional chairs in the upcoming competition,

UOIT will make every effort to place them in one or more of its strategic research areas described above.

HIGHLIGHTS OF THE PLAN

1. Alignment with federal and provincial research and innovation priorities in the context of the Federal S&T Strategy (Advantage Canada), and the Ontario Innovation Agenda.
2. Promoting world class excellence by increasing national and international research collaborations through interdisciplinarity.
3. Building a culture of innovation through education at all levels and by recognizing innovation as a core academic activity.
4. Enhancing the research environment through more faculty engagement, celebration of research success and recognition events, timely communications, etc.
5. Strengthening and expanding activities with key provincial, national and international partners.

MOBILIZING THE PLAN

UOIT is in a unique position to contribute to the national Innovation agenda and become well integrated into it. Situated in the industrial heartland of Canada, and with a research emphasis on regional/national economic growth, UOIT is in a position to adopt a research strategy that maximizes its opportunities in becoming nationally and internationally known in areas of global significance. Specifically, UOIT will focus on:

Building Research Infrastructure: UOIT makes every effort to encourage and support its faculty to apply for CFI grants, as well as equipment grants from Provincial and Federal Tri-council agencies.

Hiring: In its new hiring, UOIT has been very strategic by developing critical mass in areas of research and teaching foci. UOIT will also be strategic in the choices it makes for any new CRC allocations.

Partnerships: UOIT continues to work in partnership with local community and businesses, provincial and federal education departments and funding agencies to ensure that its faculty members are well integrated into the “real world” and that they are able to receive financial support sufficient to attract the brightest and most promising students to its campus.

Innovation: UOIT developed at a very early stage research clusters and incubation centers in areas of significant importance to local and regional industries and community partners. With emphasis on transforming the research results to be used by the wider community, UOIT has created a strong technology transfer and commercialization office to assist faculty in establishing contacts with industry, exploring collaborative R&D projects, and providing guidance in areas such as IP, patentable technologies, and knowledge transfer.