



2017-2020  
STRATEGIC RESEARCH PLAN

Office of the Dean of Research

**ÉTS Montréal: A leader in its community**

## 2017-2020 Strategic Research Plan

Building on the tremendous growth in research activities that ÉTS Montréal has seen over the last ten years, the 2017-2020 Strategic Research Plan outlines the main challenges that must be met in order to elevate ÉTS Montréal into the ranks of the leading engineering research institutions for industry, and in a much larger sense, for society as a whole. This Strategic Research Plan is closely linked to the ÉTS 2016-2019 Global Strategic Plan.

### *ÉTS Montréal: A catalyst for innovation in engineering*

#### Main objectives of the Plan

- *To grow further as a **key** player in industrial research partnerships*

ÉTS Montréal intends to continue its growth and enhance its position as a leader in research with extremely close ties with industry. The selection of research projects will be made in collaboration with its industrial partners, and will target tangible applications in specific fields. ÉTS Montréal invites its partners to play an active role in these activities, working alongside its professors and students.

- *To become an internationally recognized **focal point** for high impact research projects and networks*

Once research projects have been selected, ÉTS Montréal and its partners will mobilize the human, financial and organizational resources required to bring them to successful completion, with a focus on excellence and international recognition.

#### Priority areas of focus for research and training

ÉTS Montréal recognizes the essential nature of diversity when it comes to research models (basic and applied), along with the need to pursue new developments in every field of knowledge. Eight priority areas of focus have been identified, each of which is associated with a number of continuously evolving multi-sectoral disciplines, in concordance with existing and future study programs.

##### Aerospace

- Advanced manufacturing (digital business, manufacturing using advanced materials, smart sensors, robotics, composites, alloys, additive manufacturing, etc.)
- Avionics, controls, drones and satellites
- Aircraft modeling and simulation (testing, aerodynamics, computational fluid dynamics, multidisciplinary design, etc.)

##### Energy

- Power electronics, energy efficiency and quality
- Renewable energies, energy management and storage
- Production, transportation and distribution of electrical energy

## Environment

- Development of tools and methods for characterizing environmental problems
- Characterization of the impacts of global environmental changes on the atmosphere, the hydrosphere, the cryosphere and the geosphere, and proposals for innovative coping solutions
- Construction of sustainable cities

## Infrastructure and built environments

- Application of advanced technologies to construction methods and construction project management
- Development of smart construction management processes
- Development of approaches and techniques aimed at improving the sustainability of existing structures
- Improvement of risk management in urban and rural environments
- Development of sustainable and resilient cities

## Materials and manufacturing

- Smart design of traditional materials based on fundamental designs, using tools such as modeling and simulation
- Development of new classes of materials, including graphene, quantum materials and nanocomposites
- Development of materials for the biomedical sector
- Optimization of traditional manufacturing processes, focusing on efficiency and respect for the environment
- Development of new manufacturing processes, including additive manufacturing and electrospinning
- Miniaturization of manufacturing processes
- Virtual manufacturing
- 3D printing
- Integration of material development procedures and manufacturing processes into overall product development

## Healthcare

- Medical imaging for deep learning related to the nervous system, neuroimaging
- Virtual and heightened reality in the field of rehabilitation engineering, along with cognitive training for athletes using virtual reality
- Speech recognition
- Biomaterials
- Modeling of physical and biological systems
- Surgical simulation
- Design of orthopedic implants, virtual ergonomics, autonomy, mobility, exoskeletons and biomimicry

## Information and communication technologies

### Connectivity:

- Wireless and optical communication systems, 5G, cognitive networks, V@V communications, digital video, Internet of Things, tactile Internet
- Optics-photonics, optoelectronics
- Microelectronics, RF components and embedded systems
- Cloud computing and dematerialization
- Cyber-security

### Intelligence:

- Artificial intelligence, machine learning
- Big data, deep learning, information fusion, blockchain
- Computer vision, pattern recognition, speech recognition, image processing
- Cognitive and self-aware networks
- Quantum computing

## Ground transportation

- Smart microgrids
- Advanced modeling of electrical networks
- Electric vehicles
- Data security
- High-efficiency energy conversion
- Electronic commerce
- Logistics chain and intermodality
- Contingency planning
- New high-performance fuels
- Efficiency of combustion engines
- Smart sensors

## Representation

As of September 12, 2017, the proportion of women holding Canada Research Chairs at ÉTS Montréal had increased to 25%, exceeding the 21% target. These positive results reflect the commitment that has been made ÉTS with respect to recruiting candidates in a male-dominated field.

ÉTS Montréal believes in the principles of employment equity and diversity, and is committed to improving the representation of designated groups (women, disabled persons, Aboriginals and members of visible minorities) in its recruitment and hiring activities. This commitment is also reflected in the application review process. ÉTS Montréal has adopted mechanisms to ensure that committees include members of designated groups, and that all committee members receive prior training aimed at avoiding unwitting prejudice. This training is also offered to those in key positions at ÉTS (Director General, department heads, Deans) with a view to increasing their awareness of the issue.

## Priority areas

The priority areas for research have been defined with a view to maintaining and developing those fields that are currently performing well, along with emerging fields. Research Chairs represent a key tool for advancing knowledge in these fields, and for making a significant contribution to inspiring excellence in research activities.

Table 1 shows the current number of Canada Research Chairs (Tier 1 and Tier 2) in each priority area. CRCs that involve more than one field are linked to their main area of focus.

Areas of focus	CRC Tier 1	CRC Tier 2
<b>Aerospace</b>	1	
<b>Energy</b>	1	
<b>Environment</b>		
<b>Infrastructure and built environments</b>		
<b>Materials and manufacturing</b>		1
<b>Healthcare</b>	1	2
<b>Information and communications Technologies</b>	1	1
<b>Ground transportation</b>		
<b>Total:</b>	<b>4</b>	<b>4</b>

Table 1: Canada Research Chairs held

## Institutional and sectoral collaboration

The synergy that exists between the various partners (institutional, private and public) and ÉTS Montréal represents one of the institution's distinct advantages. This pooling of resources allows ÉTS researchers to put their ingenuity to optimal use in strengthening the interaction between research and innovation, which leads to the development of solutions with positive social, economic and environmental impacts, reflecting the three pillars of sustainable development. Across all of its active research Chairs and research units, ÉTS Montréal is dismantling the barriers between the various engineering disciplines, and even those related to other fields of research.

**Ambient intelligence** and **advanced manufacturing** have been identified as two mobilizing challenges in the quest to attain critical mass in terms of research resources (researchers, post-graduate students, infrastructure assets, windows, living laboratories) from a variety of disciplines. These challenges are closely related to the major industrial and societal issues of our time. By focusing on these types of initiatives, ÉTS Montréal can expect to enhance its reputation, and ultimately solidify its position of leadership as a key partner in connection with major Canada-wide subsidy programs.

## Tracking progress

At ÉTS Montréal, assessing the progress and performance of research activities is primarily based on the triennial reports produced by each certified research unit and the annual research report from the Office of the Dean of Research. This report details the success of researchers with respect to the various peer-reviewed grant competitions and the signing of contracts with industry. In addition to awarded grants and publications, other factors that are taken into consideration in assessing the performance of research activities include supervision of post-graduate students and technology transfer activities.

## Planning and approval process

The Director General of ÉTS Montréal is responsible for the Strategic Research Plan, which has been developed, under his guidance, by the Dean of Research, who is tasked with collecting and analyzing information and conducting the consultations required for the proper preparation and periodic updating of the Plan. This Strategic Research Plan, along with any modifications that may be made hereto, must be approved by the ÉTS Board of Governors.