NRC·CNRC

Supporting the evolution of the defence and security industry through innovation

National Research Council Canada
Conseil national de recherches Canada

Canada

As the Government of Canada's largest science and research organization, the NRC conducts research and technology development for clients and partners delivering security and defence solutions that span air, land and sea transportation, infrastructure and buildings, controlled goods, and intelligence.

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Our team can help you

- solve your most challenging technical problems
- trigger new ideas and technology innovation
- accelerate time to market for your products
- validate your technology choices
- reduce costs and help you grow revenues

We have the unique competitive advantage of being able to draw on experts both within and across disciplines, generating real solutions for clients and partners by:

- making critical infrastructure and buildings more safe and secure
- improving the effectiveness of armoured systems
- extending vehicle service life and increasing ground fleet efficiency

- enhancing performance and reducing operating costs of air vehicles
- improving ship and submarine performance, especially in the Canadian Arctic
- deepening analytics for meaningful and actionable data

Expert capabilities

Our focus areas

Energy efficient, intelligent, high performance buildings

We develop and validate technologies to transform facilities into high performance buildings that generate more energy than they consume.

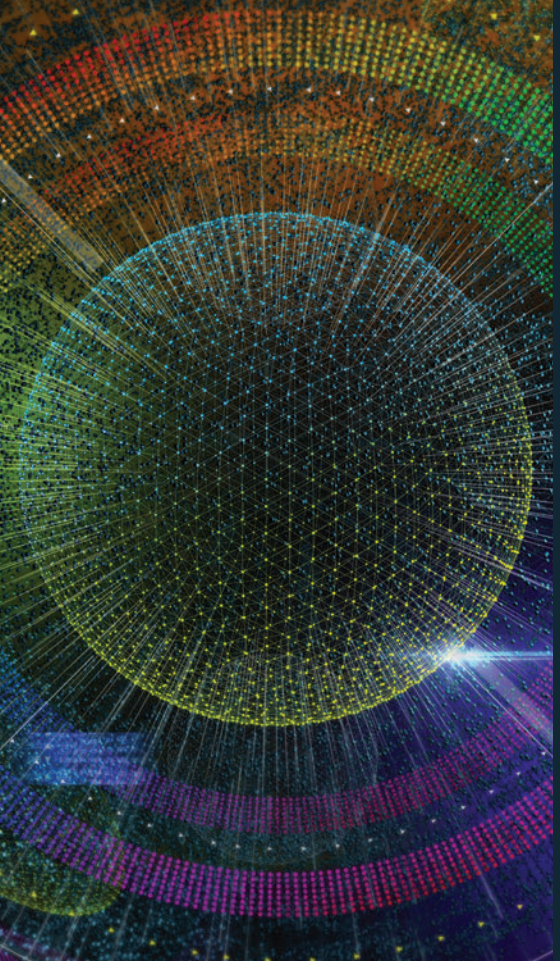
Our expertise addresses whole building performance: from advanced envelope materials and lighting to building controls and smart grid integration. Our unique approach is grounded in human factors to increase productivity and the well-being of tenants – while reducing energy consumption and carbon emissions.

Infrastructure safety and security

We increase security and longevity of critical infrastructure by applying our knowledge of advanced materials properties, acoustics, blast, lifecycle assessment, earthquake and fire science as well as structural health systems for developing innovative protective technologies, including a unique radio frequency shielding concrete to block all signals.

We work with our clients to make buildings and infrastructure more resilient to climate change and that last 100 or even 500 years. In addition, our services include structure life predictions, volatile organic compounds and radon remediation, corrosion prevention, and speech security.





Advanced data analytics and natural language processing

Quickly interpreting and making sense of massive volumes of streaming and static data is critical for both public and enterprise security as well as for timely decision-making.

We raise the productivity and reach of intelligence analysts with big data analytics and offer the power of machine learning to deliver statistical machine translation, sentiment, emotion and stance analysis, social media analytics, information extraction, aberration detection and alerting, and multivariate and parametric analysis for complex systems.

3D simulation and imagery processing and exploitation

Visualizing data and understanding information from afar is becoming critically important to defence and security operators and analysts. The NRC's capabilities in spatial 3D data modelling allow for a wide variety of analysis and simulation, including automated processing of huge datasets, statistical analysis of human shapes, sensor system design and simulation, and the large scale visualization and awareness of remote locations.

Our airborne Intelligence, Surveillance and Reconnaissance (ISR) sensor systems expand this even further, allowing for advanced simulation for design, system optimization, procurement and mission planning, interactive large-scale graphical environments and the development of accurate physical models.

Digital privacy and security

In today's digital landscape, protecting the privacy and cybersecurity of data is vital. Increasingly, the products and services we all rely on depend on data and information technology. The NRC aims to make Canada a more secure and data-enabled nation, while protecting the privacy interests of Canadians.

We bring together extensive expertise not only in the IT-related domains of digital privacy, cybersecurity and responsible AI, but also in the application domain industries in

which these technologies are deployed. The NRC's position as a non-regulatory government organization allows us to provide independent expert advice – with an awareness not only of specific digital privacy and cybersecurity challenges, but also the environment in which the technologies will ultimately need to function.

Human factors in flight

Aerospace environments present significant challenges to the health, comfort and efficiency of human operators and passengers. To improve the comfort of travellers and aircrew, safety and en route efficiency, we support clients in the design, fabrication and testing of new and innovative aerospace products.

Our experts evaluate new cockpit technologies, including helmet mounted displays, night vision goggles and advanced flight controls. Our capabilities span human systems integration (performance assessment, workload, fatigue); physiological monitoring (eye tracking, heart rate and variability, respiration, pulse oximetry, muscle and brain activity); and subjective measures, such as thermal comfort, pain discomfort and fatigue.

Training and competency analytics

In the last 2 decades, learning has changed significantly as organizations must adapt to changing circumstances. They are continuously searching for innovative ways to leverage digital technologies such as artificial intelligence to optimize how they train staff. In the defence and security industry, this includes military personnel, soldiers, sailors, first responders and more.

The NRC has capabilities related to training and competency development. With a collection of learning services and advanced analytics, we enable organizations to more efficiently deliver personal training to employees and collaborators while reducing overall training and performance support costs.

Advanced materials

We understand that next-generation capabilities in protection, sensing, lightweighting, communications and more rely on revolutionary materials and manufacturing techniques. Our unique expertise in manipulating matter at the nano scale unlocks transformational new concepts and capabilities, to tackle some of defence and security's toughest challenges.

Quantum science

As information network usage and adversarial computing power continue to grow, current encryption and information security techniques are becoming progressively more vulnerable. Guaranteed "quantum-secure" communications and data storage are increasingly desired. Canada aims to be a leader in this fast-growing field through its new National Quantum Strategy.

We are building the essential components of quantum technology systems, including quantum random number generators, quantum sensors, quantum repeaters, on-demand photon sources and other quantum devices. We work with clients to develop provably secure quantum key generation and quantum key distribution for future-proof encryption and to enable ultra-secure high-speed communications.

Advanced air mobility

The advanced air mobility (AAM) industry is rapidly growing worldwide. Similar to the manned aviation in its early days, it has roots in the technologies that have proven their value in a military context, but are yet to be fully exploited for commercial purposes.

The NRC has taken a proactive leadership role in adopting and advancing AAM technologies in Canada to meet the needs of industry. We are working to develop critical enabling technologies and prove commercial value of AAM through mission-oriented demonstrations in Canadian industrial sectors.

Reducing the cost of air defence

Maintaining existing and future Royal Canadian Air Force (RCAF) fleets comes with a heavy financial and environmental burden for Canada. We aim to reduce fuel consumption, emissions and cost of RCAF maintenance and repair operations. We offer access to technology development, demonstration and airworthiness certification facilities, as well as expertise required to help bring new technologies to market.

OP Impact, DND/CAF

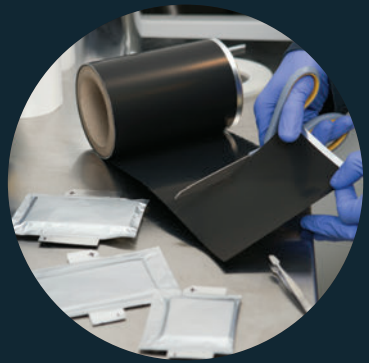
Vehicle mobility dynamics and simulation

For heavy road and rail vehicles, vibration and shock are a constant and often costly fact of life. To study these dynamics and manage their effects, our experts work with clients and partners to study and test vehicle vibration, reproduce vehicle responses measured in the field, and conduct simulations and analysis of wheeled and tracked vehicles in various operating conditions.

Power management

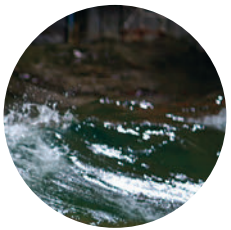
We develop intelligent power management systems for various operational applications where power is needed in the right place and at the right time. Focusing on 3 energy saving opportunities–fuel conservation, alternative fuels and intelligent fuel use–we will develop the right solution to meet your specialized power management needs.

Our expertise includes design, analysis and prototyping of vehicles and systems, multiple power source switching, fuel cells, alternate fuels and electrification.



Marine vehicle safety and performance

Our Ocean, Coastal and River Engineering experts develop advanced control and analysis systems, software tools and other innovative solutions that improve the performance and safety of marine vehicle operations and optimize vessel design.



With testing facilities for physical and numerical modelling as well as full-scale field trials, we provide complete solutions to a wide range of complex problems involving marine vessels, including station keeping, autonomous navigation, submarine hydrodynamics, and safe and sustainable operations in ice and other harsh environments.

Research in Arctic regions

Canada's Arctic is a vast region full of opportunities and significant engineering challenges. We work to ensure environmentally safe and sustainable economic development and community infrastructure necessary to support it.

Working with Northern communities, industry clients, government regulators and academia, we address resource development and northern transportation issues. We focus on providing safer and more efficient shipping routes, improved oil spill detection, countermeasures, clean-up methods in ice and ensuring more reliable ice road operations. Our efforts increase the likelihood of survivability in the event of an emergency evacuation from vessels in ice-covered waters and from offshore platforms.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Our unique facilities and technical services

Unique research infrastructure with leading-edge equipment

Heavy vehicle tilt facilities

Fleet operators, designers and modifiers rely on our heavy vehicle tilt facilities to understand the static roll threshold of their military vehicles, tractor-trailers, tankers, or any other surface transportation vehicle.

The facilities include a hydraulically actuated tilt table, electronic wheel scales for all axle groups and an extensive range of instruments that measure table angle, suspension angle and body angle. They are all designed to measure the static roll threshold and stability of any vehicle used in Canada, at any load level. The tilt table is also used to measure load transfer ratio, wheel and axle loads and suspension roll centre heights.

Rail impact hill

In freight yards and on railway lines across North America, rail vehicles are frequently subjected to considerable strain and impacts measured in hundreds of thousands of pounds.

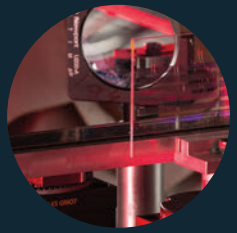
To ensure that cars and their cargo can withstand these stresses, our Rail Vehicle Impact Ramp offers more than a hundred channels of instrumentation to test, certify and improve performance.

The Association of American Railroads accredited facility offers testing for military cargo systems, intermodal container cars, automobile carriers and tank containers.

Pressure, temperature and stress/strain sensing in extreme conditions

Our next-generation Fibre Bragg Grating (FBG) technology is ideal for sensing applications in extreme environments of temperature, pressure and radiation, where conventional methods fail. With our deep expertise in optical sensors and advanced nonlinear optical methods, we will help industry to commercialize powerful yet cost-effective solutions that deliver results in real-time and in harsh environments.

Sensors can be developed for a number of sectors, including the aerospace industry, where information related to structural health monitoring, engine temperatures and loads can be particularly valuable.



Structural dynamics facility

Our structural dynamics facility–one of North America's most versatile vehicle vibration testing facilities–addresses a wide variety of vibration and shock issues.

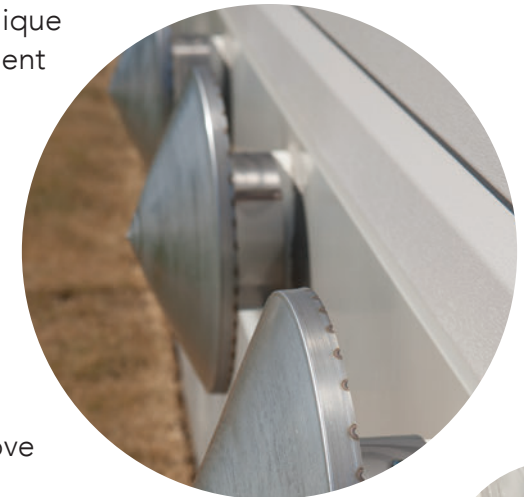
In the lab, a selection of hydraulic actuators can be configured to provide inputs to your vehicle, sub-system or component as required. Software can be used to guide our actuators to generate precise reproductions of field-measured forces and displacements or we can generate a variety of vibration patterns to sweep through problem areas and pinpoint issues.

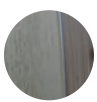
Flight research laboratory

The NRC develops technologies to improve pilot performance, flight operations, passenger and air crew experience and to extend fleet service life. Our experts maintain a fleet of highly specialized and customizable research aircraft as well as the Centre for Air Travel Research, which is a state-of-the-art end-to-end air travel simulation facility, to assist industry with the testing flight research and technical maturation demonstration of aeronautical technologies in the areas of airborne research, flight mechanics, autonomy and cabin technologies.

World's only indoor air research laboratory

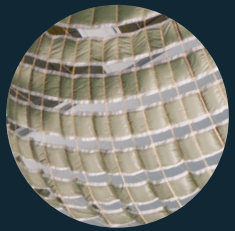
Our researchers have designed and built a unique full-scale laboratory to understand air movement under realistic but controlled conditions. This test facility has flexible modules that duplicate specific room sizes and designs in actual buildings, as well as different types/configurations of heating and air-conditioning systems, air cleaners, filters and heat-recovery ventilators. Our ventilation and air quality experts work together with industry to design and access the impact of systems and strategies to improve indoor air quality while considering energy-efficiency.





Wind tunnels

The NRC offers 6 wind tunnels located in Ottawa, Ontario, to support industry, government and university clients. Our wind tunnels are home to aerodynamics experts that provide services to clients in the aviation industry and work on many non-aeronautical applications such as bridges, tall buildings and surface vehicles.

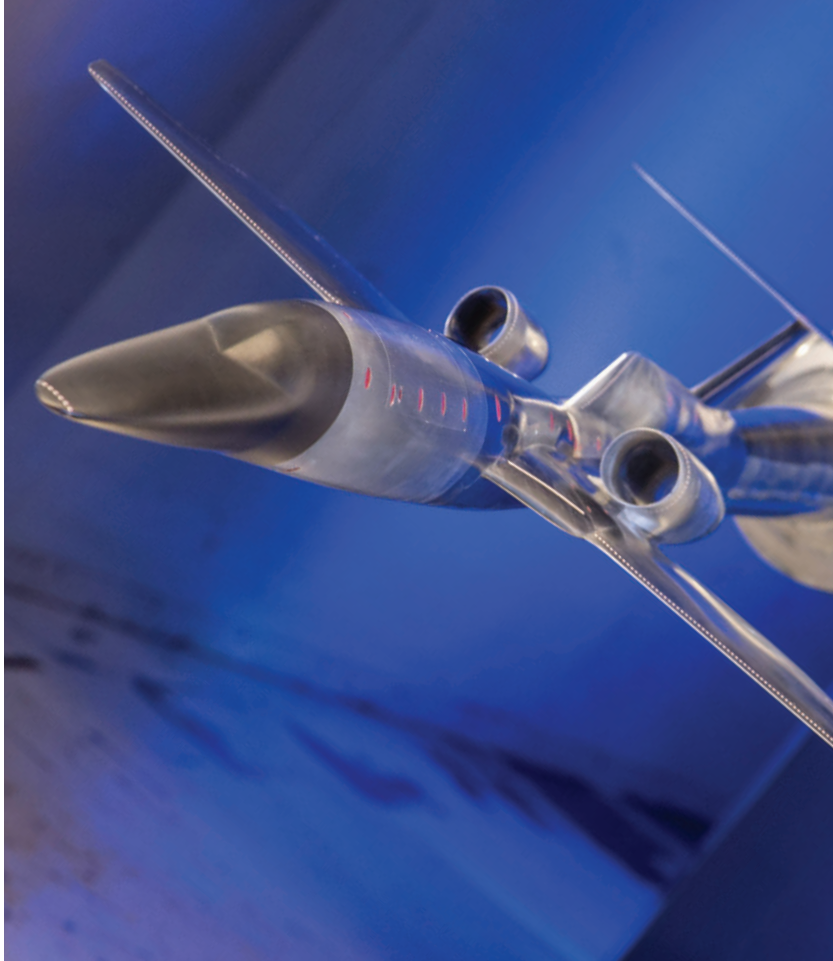


We have been involved with wind-loading studies for some of the world's major structures and are recognized worldwide for our surface vehicle aerodynamics expertise.

Our facilities include:

- 1.5 m trisonic pressurized wind tunnel capable of running in the subsonic, transonic and supersonic flow regimes
- 2 m by 3 m wind tunnel, for subsonic aeronautical and industrial testing

- 3 m by 6 m icing wind tunnel, which bridges the gap between a conventional wind tunnel and an engine test cell
- 9 m wind tunnel, for aerodynamic testing of aeronautical and non-aeronautical objects, including surface vehicles, ground-based structures and parachutes
- altitude icing wind tunnel, used to simulate in-flight atmospheric icing conditions at altitudes up to 12.2 km
- 0.9 m wind tunnel, which can be used for small-scale studies



Structural full-scale test facility

Serving clients with proof-of-concept, life extension and certification needs, including static, fatigue, durability and damage tolerance tests ranging from entire airframes down to the subsystem, component and hybrid-structural level. We conduct airframe digital twin technology demonstrations, as well as full-scale testing, and ballistic, environmental and fire exposure testing under loads. Our equipment includes:

- Hydraulic actuators, load cells
- Multi-channel fatigue and static test control systems
- Thousands of channels of data acquisition systems
- Overhead crane
- Specialty environmental chambers
- Advanced non-destructive evaluation (NDE)

Climatic testing

No design process can foresee every way that nature will penetrate and disable your product or equipment. Climatic testing, however, will expose a large portion of product deficiencies, right before your eyes.

Our climatic testing facility, one of the largest and most versatile of its type in North America, provides a single location to test performance under an exceptionally wide range of conditions, producing temperatures ranging from -51 °C to +55 °C. Whether your application is climatic evaluation of an HVAC system in full-size rail cars, the testing of a new de-icing agent or a torsion test for new systems in a military vehicle, our facility will get you there faster and with greater certainty.

Mobility simulation

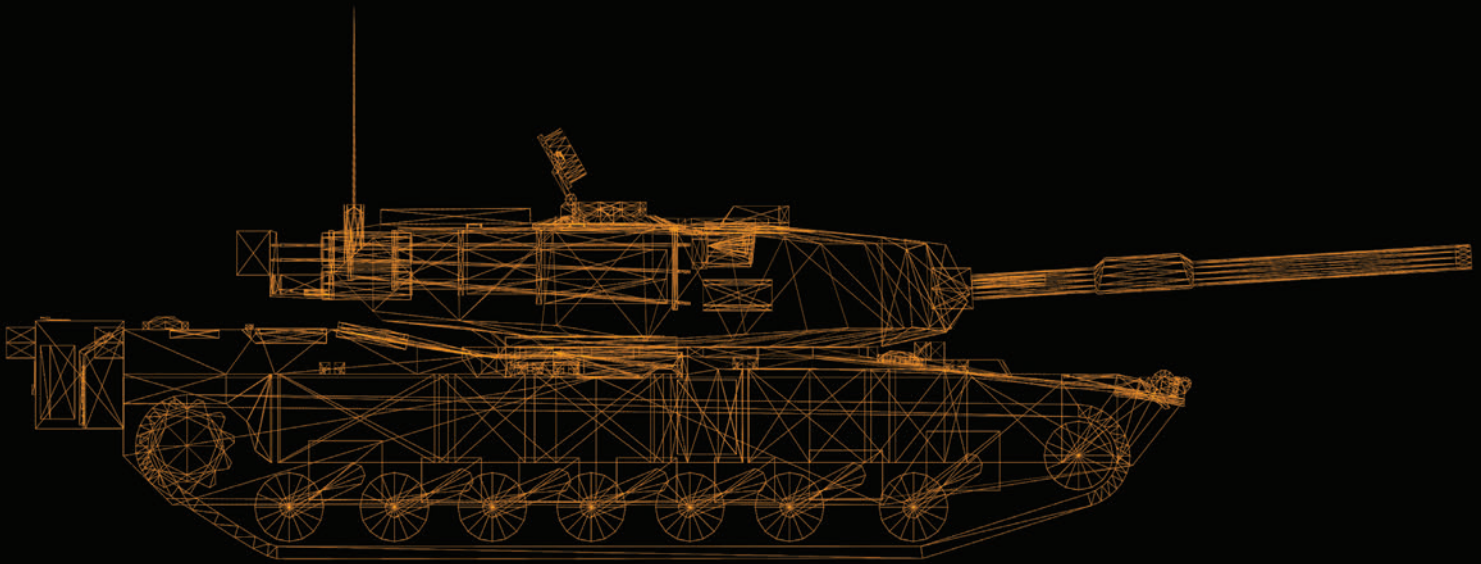
Our mobility simulation facility assists clients with the design and analysis of suspension systems for heavy road and rail vehicles, non-road mobile machinery and physics based geometric vehicle models.

Vehicle and platform integration

Adding a new kit into existing fleets, or an existing kit into new fleets? Our expansive facility provides experts and equipment to support these activities and includes Military Standard design, testing and prototyping.

Virtual vehicle proving ground

Military Standard testing in a 3D computer simulation environment, which allows our experts to quickly change parameters, optimize design and perform assessments and comparison evaluations.



Marine towing tank

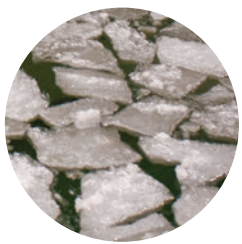
Our towing tank is used to simulate marine conditions and evaluate the performance of a range of marine systems, including warships, bulk carriers, patrol vessels, sailing yachts, icebreakers and submarines.

This tank is capable of producing regular waves of up to 1 m or irregular waves of up to 0.75 m. The carriage is a precision controlled mobile laboratory with maximum speed of 10 m/s.

Ice tank

This indoor, refrigerated facility simulates Arctic and northern marine conditions and is a versatile ice modelling facility that has been used to study dozens of ice-related challenges. It is used for many types of studies, including understanding navigation in Arctic conditions and modeling of ice structure interactions. The tank has also been used to investigate the effects of ice scouring seabed material.

With a usable ice sheet of 76 m, our ice tank is the longest in the world.



Offshore engineering basin

The NRC's offshore engineering basin is one of the world's most advanced indoor model ocean facilities. Measuring 75 m × 32 m, the basin can generate waves, current and wind to simulate real-world marine conditions. This basin is used to assess the efficiency and safety of marine technologies and evaluate concepts in a controlled environment. Tests performed in this facility include but are not limited to, seakeeping, maneuvering, wave energy conversion, wave impact loads on ships and offshore structures as well as tow out, set down and operation of offshore structures.

Battery performance and safety evaluation

Battery systems are critical for providing safe and dependable power and energy solutions for both mobile and stationary applications in a range of environments. We work with our clients to bring ideas to life while avoiding costly mistakes by providing evidence-based solutions on the electrical, structural and thermal design of battery systems. We apply our expertise to characterize battery performance and safety at all scales, from single cells to electric vehicle packs, in various environments and uses. Our deep knowledge of the range of battery systems on the market allows us to evaluate a potential prototype or quality of a product that is being considered for integration in a system.

Microgrid facility

Our microgrid facility validates, tunes and tests renewable energy resources and energy storage systems as a part of future plans to deploy hybrid technologies in remote North Warning System sites. Our experts are leading the effort to develop energy management systems and dynamic control algorithms to help partners meet their greenhouse gas emissions reduction targets. We visit different sites to perform assessments of the power and control systems and acquire measured data to develop optimized models suitable for hybrid power system operation.

The NRC supports and nurtures a passion for science, technology, engineering and mathematics (STEM) among women. Diversity in science and research expands the pool of talented researchers, bringing in fresh perspectives, talent and creativity. Want to be part of our innovative team? Apply here: **canada.ca/nrc-careers**

Industrial Research Assistance Program

The National Research Council of Canada Industrial Research Assistance Program (NRC IRAP) is Canada's leading innovation assistance program for small and medium-sized businesses. The program is delivered by an extensive network of industrial technology advisors located in offices across Canada who understand the opportunities and evolving challenges you may face as an entrepreneurial and innovative company.

We provide specialized services to help you accelerate the growth of your business and take ideas to market. We offer eligible firms financial assistance, advisory services and connections to the best business and R&D expertise in Canada.

If your growth is dependent on technological innovation, we can support you through every aspect and at every stage of the innovation process to achieve commercial success.

Contact

canada.ca/nrc-irap
1-877-994-4727

Contact us today to see about how we can help

The NRC is the partner of choice for clients that want to develop innovative products and services worldwide. Our scientific teams offer purposeful research that solves challenging technical problems, triggers technology innovation and new ideas, increases certainty about technology choices and delivers unique solutions to tomorrow's challenges.

Contact us if you are interested in:

- developing innovative products
- technical or testing services
- customized research
- renting an NRC facility
- licensing opportunities
- advisory services

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