National Research Council Canada

2018–19

Departmental Results Report

The Honourable Navdeep Bains, P.C., M.P.
Minister of Innovation, Science and Industry

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Minister's message

I am pleased to present the 2018–19 Departmental Results Report for the National Research Council of Canada (NRC).

Over the past year, the various organizations in the Innovation, Science and Economic Development Portfolio have together worked hard to make Canada a global innovation leader and to build an economy that works for everyone.

Our primary objectives were, and continue to be, to empower businesses to reach their innovation potential to compete in a global, knowledge-based economy; to enhance Canada's economic strengths by supporting science and research; and to promote Canadian tourism. These objectives were supported by new and existing policies and programs designed to help Canadian entrepreneurs from across the country and from diverse backgrounds grow and reach new markets. We also continued to implement multi-year investments in science, including historic investments in fundamental research, while our robust tourism industry was bolstered by support for national initiatives.

In 2018-19, the NRC leveraged Budget 2018 funding to expand its assistance to small and medium-sized enterprises, implement collaborative science and research initiatives, such as the Collaboration Centres and Ideation Fund, and support key strategic government priorities, through the Innovation Superclusters Initiative and its challenge missions. As well, internal initiatives at the NRC, including NRC Dialogue and "re-imagining NRC", enhanced the organization's focus on research excellence and contributed to a renewal of NRC's workforce and facilities.

These are just a few examples of the NRC's work on behalf of Canadians through collaboration, dialogue and partnerships across the country. I invite you to read this report to learn more about how we are working with and for Canadians to build our innovation nation.

The Honourable Navdeep Bains
Minister of Innovation, Science and Industry
Mandate Letter[i]

President's message

The NRC has a century-long history advancing knowledge, addressing government public policy challenges, and supporting business innovation.

Two years ago, we undertook a "reimagining" of the NRC, positioning our expertise and facilities as collaborative platforms for Canada to convene the people and ideas required to deliver breakthroughs and solutions in areas that matter to us all. Budget 2018 provided us with the funding required to implement these new ideas at scale, including, more exploratory research through an Ideation Fund to incent grassroots partnerships between our researchers and universities and industry; expanded assistance to scale up small and medium-sized enterprises (SMEs) through the National Research Council Industrial Research Assistance Program (NRC IRAP); and reducing fees charged to SMEs for our services. We are also supporting strategic initiatives such as Canada's five Innovation Superclusters, and we are organizing teams of NRC and external researchers to address challenge missions[ii] identified by our Ministers.

Although a significant focus for us during 2018-19 was on implementation of these important Budget 2018-funded initiatives, a "re-imagined NRC" has also driven a range of internal initiatives. For instance, we have enhanced our focus on research excellence through an NRC President's Research Excellence Advisory Committee – having created a President's Science Advisor position, held by Dr. Greg Smallwood, and appointed a Chief Science Officer and Departmental Science Advisor, Dr. Danial Wayner, to work with Canada's Chief Science Advisor, Dr. Mona Nemer. We have also worked to increase our workforce diversity and renewal of our staff. This has involved mandatory diversity training in managing bias in hiring for all NRC managers and initiatives to increase the number of students and post-doctoral fellows.

We have continued to work on the renewal of our facilities, ranging from the completion of new research facilities for automotive research in London, Ontario and aircraft cabin interiors in Ottawa, advancing construction of new NRC buildings in Mississauga and Winnipeg, and investing in new equipment and tools, such as computing infrastructure for artificial intelligence and quantum theory. We have also increased our connections with leading research partners. In Canada, this has involved establishing collaboration centres with universities, and increasing international collaboration opportunities with the United Kingdom, Germany, and Japan.

In 2018-19, these new initiatives already began yielding results for Canadians, including:

- Over 1,000 papers published in peer reviewed journals such as *Nature* and *Science* (this averages out to 48 publications per 100 NRC scientists/engineers/technicians).

- Over 200 patent applications filed, with a stock of 1,670 patents maintained.
- NRC Research Centres worked with close to 1,000 clients, collecting $193M in revenues from external partners.
- 90 percent of NRC Research Centre clients indicated that working with the NRC resulted in positive benefits for their organization, such as increased research and development (R&D) capacity and increased sales or job creation.
- Funded innovative projects in more than 3,500 Canadian SMEs through NRC IRAP and provided advice to an additional 4,600 companies.
- Helped NRC IRAP-funded clients grow their revenues by 27 percent and employees/jobs by 18 percent (from 2015 to 2017).

These new initiatives and results were realized, while at the same time, keeping an eye on future priorities by developing a five-year strategic plan for the organization. I look forward to the contribution we will make in the coming year, as we continue to re-imagine the potential that the NRC holds for Canada.

Mr. Iain Stewart
President
National Research Council Canada
Mandate Letter from the Ministers[iii]

Results at a glance

What funds were used? (2018-19 Actual spending)	Who was involved? (2018-19 Actual full-time equivalents)
$1,145,203,852	3,950

For more than a century, the NRC has continually evolved to build and maintain its role in the Canadian science, technology and innovation ecosystem. The NRC's role in research excellence and collaboration in Canada was recently reinforced and recognized through the Government's Innovation and Skills Plan[iv] and through Budget 2018, which increased the NRC's ongoing annual funding by an unprecedented $258M.

In its first Departmental Results Report (DRR) aligned with the NRC's Departmental Results Framework, the NRC is pleased to present its progress towards its Core Responsibility of Science and Innovation and, more specifically, the three departmental results it seeks to deliver for Canada and Canadians: Scientific and technological knowledge advances; Innovative businesses grow; and Evidence-based solutions inform decisions in government priority areas. This DRR reports against the targets and plans set out in the NRC's 2018-19 Departmental Plan and outlines the resources allocated toward achieving these results.

Scientific and Technological Knowledge Advances

In 2018-19, the NRC exceeded all of its performance targets in relation to this departmental result. Of note, NRC research leaders generated 1,153 unique intellectual assets, which includes peer-reviewed publications, patents, disclosures and trade secrets. Other notable results included:

- The NRC appointed its Departmental Science Advisor and Chief Science Officer, Dr. Danial Wayner and established the President's Research Excellence and Advisory Committee (PREAC) and the President's Science Advisor, Dr. Greg Smallwood.
- The NRC launched new collaboration and innovation initiatives in 2018-19 through the establishment of an Ideation Fund and formalizing six agreements for Collaboration Centres with universities.
- The NRC provided support to NASA's New Horizons space probe, which achieved the farthest flyby in history to photograph Ultima Thule.
- The NRC contributed to a milestone in metrology by leading the Canadian delegation in voting for the revision of the International System of Units (SI), changing the world's definition of the kilogram and contributing a value of Planck's constant with the lowest uncertainty ever achieved.
- The NRC announced a breakthrough in the development of an in vitro blood brain barrier model using stem cells that will further research into medications for brain diseases, such as Alzheimer's and dementia.

Innovative Businesses Grow

In 2018-19, the NRC exceeded two of its performance targets in this departmental result. Of note, firms engaged through the National Research Council Industrial Research Assistance Program (NRC IRAP) experienced 27 percent revenue growth and 18 percent growth in science and technology-related jobs. Other notable results included:

- 90 percent of NRC's clients reported positive benefits from working with the NRC, such as increased jobs, sales, or R&D expenditures[1].
- NRC IRAP provided financial contributions to over 3,500 firms, enabling its innovative clients to support over 15,600 Canadian jobs. NRC IRAP also provided advice to an additional 4,600 unfunded firms.
- Leveraging additional funding allocated in Budget 2018, NRC IRAP approved 29 projects greater than $1M to support high potential firms.
- Amendments to *The NRC Act*[v] were approved in December 2018, which provided increased flexibility to the NRC in the management of current and emerging intellectual property.

Evidence-based solutions inform decisions in government priority areas

In 2018-19, the NRC exceeded its revenue target for collaborative work with other government departments by 33 percent and generated 1,279 publications related to government priorities. Other notable results included:

- The NRC supported the federal Innovation Superclusters Initiative[vi] through access to NRC research facilities, scientific and technical resources, project assessment services, and advice on intellectual property.
- The NRC finalized plans to make electronic copies of building codes free via the Internet.
- The NRC opened a Centre for Air Travel Research that simulates the passenger experience, with the overall aim to enhance comfort and safety.
- Leveraging funding from Budget 2018, the NRC launched four large-scale collaborative R&D initiatives in government priority areas (see page 14): High-throughput and Secure Networks; Disruptive Technology Solutions for Cell and Gene Therapy; Materials for Clean Fuels; and Artificial Intelligence for Design.

Internal Services

In 2018-19, the NRC's internal services enabled the organization to deliver strong performance against its three Departmental Results and positioned the NRC for long-term growth and success. Notable results included:

- The NRC continued its implementation of NRC Dialogue[vii] action plans with 77 percent of Dialogue actions considered complete.
- The NRC developed a five-year Strategic Plan, which sets out five strategic areas of focus that position the NRC to address critical national and global challenges over the next five years and beyond.
- The NRC developed a Strategic Human Resources Plan to enhance the organization's ability to attract, develop and retain a diverse, talented, healthy and engaged workforce.
- Began a review of all NRC major facilities.

For more information on the National Research Council's plans, priorities and results achieved, see the "Results: what we achieved" section of this report.

[1] The 2018-19 Client Satisfaction Survey represented 159 clients across all of NRC service offerings, from large scale R&D and technology development projects to short-term tests. The specific clients and initiatives surveyed vary by year.

Results: what we achieved

Core Responsibility

Science and Innovation

Description

Grow and enhance the prosperity of Canada through: undertaking, assisting and promoting innovation-driven research and development (R&D); advancing fundamental science and Canada's global research excellence; providing government, business and research communities with access to scientific and technological infrastructure, services and information; and supporting Canada's skilled workforce and capabilities in science and innovation.

The NRC has three departmental results for tracking and reporting against its core responsibility:

- scientific and technological knowledge advances;
- innovative businesses grow; and
- evidence-based solutions inform decisions in government priority areas.

Results

Departmental Result 1: Scientific and technological knowledge advances

The NRC continually strives to achieve and surpass its goals in research excellence. In 2018-19, the NRC exceeded all of its targets for advancing scientific and technological knowledge, obtaining a citation score of 1.51 for NRC-generated publications, relative to the world average and generating 1,153 unique intellectual assets, including peer-reviewed publications, patents, disclosures and trade secrets. Of note, the NRC published two articles in the journal *Science* on wheat genome sequencing that involved 13 years of collaborative research with over 200 scientists from 20 countries.

To support the NRC in sustaining science and research excellence, several notable advisory functions were established and implemented in 2018-19.

- The President’s Research Excellence Advisory Committee (PREAC) was announced in April 2018, supported by the newly appointed President’s Science Advisor, Dr. Greg Smallwood.
- Dr. Danial Wayner was appointed as Departmental Science Advisor and Chief Science Officer in October 2018.
- NRC Research Centres established External Advisory Boards to provide external advice on strategic plans and research initiatives, as well as ensure effective engagement between leading national and international experts and the NRC.

In 2018-19, the NRC also saw results in research excellence through collaboration and innovation initiatives enabled by Budget 2018 funding.

The NRC established an Ideation Fund to foster transformative research ideas generated by NRC scientific personnel working with external collaborators. Through the New Beginnings Initiative, which supports small-scale research projects led by individual NRC researchers for a period of up to one year, 52 projects were approved and 44 grant agreements with external collaborators were established last year, totalling $917K. The Small Teams Initiative, which supports exploratory research project ideas by NRC teams for a period of up to three years, launched its inaugural round last year with the selection and launching of projects in 2019-20.

Furthering its experimentation efforts, the NRC forged new alliances with universities in 2018-19 to grow Canada's skilled workforce, pursue discoveries, generate intellectual property and commercialize new technologies. In 2018-19, efforts were underway to establish 10 Collaboration Centres across the country, with six agreements signed.

Collaboration Centre	Partner
Centre for Research and Applications in Fluidic Technologies (CRAFT) The centre will focus on applications for microfluidics such as rapid in vitro disease diagnostics, organ-on-a-chip engineering to test how organs respond to medicines using simulations on small devices, and bio-printing of tissues for personalized regenerative medicine and therapeutic applications.	University of Toronto
Collaboration Centre on Green Energy Materials The centre's focus will be on discovery and development of advanced materials for energy conversion and storage devices.	University of Toronto (Mississauga)
Karluk Collaboration Space The centre will lead innovation in ocean engineering, technology and science to better enable world-leading research in a variety of areas such as maritime technology, oceanography, and naval architecture engineering.	Memorial University of Newfoundland
CIC-NRC Cybersecurity Collaboration Consortium The centre will conduct innovative research for critical cybersecurity infrastructure with a focus on Internet of Things, security, artificial intelligence, human-computer interaction, and natural language processing.	University of New Brunswick
Joint Centre for Extreme Photonics The Centre will conduct collaborative research in ultrafast quantum photonics, molecular photonics, high-resolution high-accuracy clocks, and opt-electronics to capitalize on significant talent and infrastructure and provide succession planning for some of Canada's most eminent scientists.	University of Ottawa
NRC-Waterloo Collaboration on Artificial Intelligence, Internet of Things, and Cybersecurity This Centre will conduct world-class research in the Internet of Things, artificial intelligence, cybersecurity, and privacy to integrate into products and services to improve Canadian manufacturing, health and fitness, national security, and energy, which will encourage economic activity in the local and Canadian marketplaces.	University of Waterloo

The NRC also contributed to the advancement of important scientific knowledge and technologies to improve the quality of life of Canadians and support global research excellence.

- Supported by NRC IRAP's bilateral program with Germany's ZIM, the NRC launched a joint research project, partnering Technische Universität Braunschweig and Compositence from Germany with the Canadian company NUCAP Industries, to investigate the manufacturing of hybrid parts using polymer composite and metal in a one-step forming process.
- NRC researchers, Dr. Edmond Lam and Dr. Alfred Leung, developed a patented process to turn crustacean shell waste, a serious disposal problem in the seafood industry, into valuable biopolymer nanocrystals. These researchers are now collaborating with green chemistry expert Dr. Audrey Moores, from McGill University, to promote the use of shell waste for next generation materials.
- An NRC research team announced a breakthrough in the development of an in vitro blood brain barrier model using stem cells to further research into medications for brain diseases, including Alzheimer's disease, amyotrophic lateral sclerosis (ALS), dementia, neural infections, epilepsy, and Zika virus.
- The NRC made significant contributions in the field of astronomy, highlights include:
    - NRC scientists used images from the Canada-France-Hawaii Telescope to enable NASA's New Horizons space probe to perform the farthest flyby in history, by re-directing and flying within 3,500 km of Ultima Thule, an object in the Kuiper Belt.
    - The NRC continued to participate in pre-construction of the Square Kilometre Array, the next generation radio telescope. It contributed to the Central Signal Processing, the "brain" of the telescope, and supplied technology for the sub-reflectors and receiver low-noise amplifiers for the precursor telescope, MeerKAT in South Africa.
    - 2018 marked the 100th anniversary of the Dominion Astrophysical Observatory[viii] in Victoria, B.C., whose Plaskett Telescope was Canada's first publicly funded major science project and continues to provide important data and observations.
- The NRC made significant contributions to the field of metrology. Of note, the NRC led the Canadian delegation, voting in a landmark decision to revise the International System of Units (SI), changing the world's definition of the kilogram. An NRC team contributed a value of Planck's constant — a measure of action in quantum mechanics that determines mass — with the lowest uncertainty ever achieved. The team had to account for imperceptibly small effects, such as gravitational changes caused by the moon and volumes of groundwater from melting snow to achieve this precision.

- The NRC continued to support advanced research in sub-atomic physics through stewardship and contribution payments of $57.3M to TRIUMF.[ix] The 2018-19 evaluation of TRIUMF[x] found that the facility is critical to meeting the needs of a growing Canadian sub-atomic research community. It plays an important role in supporting Canada's performance and reputation in TRIUMF-related fields and contributes to important research and significant discoveries, for example the first observation of Lyman-alpha transitions in antihydrogen, at CERN, the European Organization for Nuclear Research, a key step in understanding fundamental concepts in physics and astronomy and our universe.
- The NRC and the University of Ottawa combined expertise to create the Joint Centre for Extreme Photonics[xi] (JCEP), which will focus on collaborative R&D in ultrafast quantum photonics, high-resolution and high-accuracy clocks, and opto-electronics.

In 2018-19, several NRC researchers and alumni were recognized for their significant contributions to science:

- University of Waterloo professor and former NRC Post-Doctoral Fellow Dr. Donna Strickland received the Nobel Prize in Physics for her work on an amplification laser with numerous applications, including laser eye surgery.
- Senior Research Officer, Dr. Pavel Cheben, from the NRC's Advanced Electronics and Photonics Program, received the Order of the Slovak Republic from President Andrej Kiska in Bratislava, Slovakia for his contributions in subwavelength integrated photonics, a game-changer in metamaterial science and integrated optics.
- Dr. Jennifer Veitch, an NRC Principal Research Officer for indoor environment, received the Illuminating Engineering Society Medal Award in recognition of her achievements in developing national and international standards in the field.

The NRC believes that a diverse workforce is fundamental to achieving its goals in advancing scientific and technological knowledge. In 2018-19, efforts continued across the NRC to increase representation across all Employment Equity (EE) groups. The NRC exceeded its performance target for women in STEM and is continuing its efforts to increase representation across all EE groups and within occupational groups.

Departmental Result 2: Innovative businesses grow

The NRC is committed to supporting the growth of innovative, high-potential Canadian businesses. Through its specialized advice, services and infrastructure, the NRC helps small and medium-sized enterprises (SMEs) reach their potential and grow to scale.

The NRC is pleased to report for 2018-19 that firms engaged with NRC IRAP experienced 27 percent revenue growth, exceeding the NRC's performance target by 2 percent. NRC IRAP-supported firms also experienced 18 percent growth in science and technology-related jobs, exceeding the NRC's performance target by 6 percent. Furthermore, the NRC's services were leveraged considerably by 962 industry clients and collaborators throughout 2018-19, generating $79.7M in revenue, just shy of the target of $80M.

In 2018-19, NRC IRAP supported a total of 8,159 firms. NRC IRAP helped innovative Canadian SMEs grow to scale and expand into Canadian and global markets through several key strategic initiatives.

- NRC IRAP worked with the Business Development Bank of Canada (BDC) to develop a process and approval criteria for delivering capital loans to high potential, innovative clients who are at a critical stage of commercialization. In 2018-19, the partnership assisted five clients to secure BDC funding. This initial success was used to define and launch a one-year pilot in Ontario in early 2019-20, the results of which will define the plans for a national rollout.
- NRC IRAP soft-launched an initiative to increase its funding maximum from $1M to $10M. With an additional $100M allocated in Budget 2018, NRC IRAP began to identify high-potential firms whose rapid growth could be stimulated by significant federal investments. In 2018-19, 29 projects greater than $1M were approved.
- NRC IRAP delivered on its commitment to help clients to access international markets and global value chains through facilitating international co-innovation. NRC IRAP, working with Global Affairs Canada, engaged 116 Canadian SMEs in 13 partnership development activities for over 2000 business-to-business meetings.
- Engaging with its partner Innovate UK, NRC IRAP supported five partnering activities with the United Kingdom (UK) in mutually agreed areas of priority: Advanced Manufacturing, Energy/Smart Grid, Artificial Intelligence, Food Processing and Agricultural Technology.
- NRC IRAP committed $36M ($15.4M in 2018-19) to 45 new multi-year co-innovation projects worth over $200M between Canadian SMEs and partners from Germany, the UK, EUREKA and Canadian International Innovation Program (Global Affairs Canada) economies. Through the Canada-Germany 2+2 pilot program, NRC IRAP, in co-operation with Canada's Natural Sciences and Engineering Research Council (NSERC), and the German Federal Ministry of Education and Research (BMBF), initiated support to six consortium projects (academic/research institute with SMEs) valued at over $4.5M.

- NRC IRAP collaborated with Global Affairs Canada through its CanExport Program to help SME export development, supporting 1,500 projects to 110 foreign markets.

The NRC advanced amendments of *The NRC Act*[v] in order to improve the NRC's ability to manage current and emerging intellectual property (IP). The amendments were considered and approved as part of Bill C-86 in December 2018, providing the NRC with increased flexibility in the transfer of technologies to partners who wish to commercialize those innovations. The NRC can now offer its partners certainty around ownership of IP, allowing them to more effectively attract business and raise capital.

In 2018-19, the NRC remained committed to applying the Government of Canada's Gender-based Analysis Plus (GBA+)[xii] analytical tool. As such, numerous research projects are considering the impacts of R&D on various populations. To support the promotion and preservation of Indigenous languages, the NRC, in collaboration with Indigenous stakeholders, launched a three-year project to convert Indigenous speech to text.

Integration of GBA+ at the NRC

A working group initiated a review of NRC IRAP activities in order to develop measures that ensure there are no unintended barriers to the participation of underrepresented groups in NRC IRAP's programs and services. This work will also lay the foundation for development of new indicators and analytics tools to support data collection and tracking of diversity; and, going forward, help maximize inclusion and reach of the program, ensuring access and impact for underrepresented groups.

The NRC continued to work with Canadian SMEs in the discovery and early development of innovative biotherapeutics and vaccines and also advanced several products closer to market. As a result of work completed in 2018-19, an anti-cancer drug is progressing through clinical trials, two vaccines are in clinical development, a promising treatment for Alzheimer's disease is in manufacturing for pre-clinical and clinical studies, and a treatment for life-threatening fibrotic disease has entered clinical studies.

In 2018-19, the NRC delivered two high-impact advanced manufacturing projects for Canadian industry that united expertise and tools from across the organization, one of which resulted in an inspection system for aircraft engines developed in collaboration with AV&R (Automation, Vision and Robotics) and Rolls-Royce. The NRC also completed a large development and technology project with Bombardier Transportation for oscillatory laser cold wire (LCW) of thick extruded profiles.

Fibos, a company from Toronto, Ontario that specializes in optical sensing solutions, worked with the NRC to design, manufacture and test an ultra-high temperature accelerometer. The initial use in jet turbine engines with the goal of improving engine fuel efficiency, could find significant application in the aerospace, drilling and power generation industries amongst others,

and is now the subject of a patent application by the NRC. This builds on NRC work developing optical based technologies for sensors and their application.

NRC clients experienced real business growth in 2018-19, with 90 percent reporting positive benefits from working with the NRC, such as increased jobs, sales or R&D expenditures. Some of the success stories include:

- Opsens Inc., a Quebec company that sells sensors for use in cardiology to medical device companies, hospitals and labs, had over $14M in sales last year to more than 500 hospitals.
- Hummingbird Chocolate in Almonte, Ontario, became an award-winning company and expanded sales across Canada. They are now exporting to Japan, China and the UK and will be opening a factory in partnership with Canopy Growth, the world's largest cannabis company.
- Black Cat Wear Parts Ltd., an Edmonton, Alberta manufacturer and distributor of wear parts for construction, mining and road maintenance, doubled their sales from 2005 to 2015 through expansion to the United States and China and sold $10M worth of products that use the company's new wear resistant overlay coatings.
- Long-time SME client of the NRC, Zymeworks Inc., now a public company, grew from seven employees in 2009 to over 230 in 2019; earned over 10 awards; attracted more than $266M in financing; and secured 13 partnership deals with nine leading multinational drug developers.
- R&D client Forbius (Formation Biologics), grew from a single employee to a company of 40 people and attracted approximately $100M in capital.
- NRC IRAP supported 1,294 youth jobs in Canadian companies through the Youth Employment Strategy with 70 percent reporting that they were employed or self-employed after the internship.

Departmental Result 3: Evidence-based solutions inform decisions in government priority areas

The NRC continues to invest in research activities that generate scientific knowledge and advice in areas of priority to the Government of Canada. The NRC also works collaboratively with other federal government departments (OGDs) to help address key challenges facing Canada and the world.

In 2018-19, the NRC advanced knowledge in areas of importance to Canada, generating 1,279 publications related to government priorities. Moreover, in support of Canadian research and innovation activities, the NRC's technical services were leveraged significantly by OGDs throughout 2018-19, generating $93.1M in revenue, exceeding the NRC's performance target by 33 percent.

In 2018-19, the NRC lent its expertise to the federal Innovation Superclusters Initiative[vi] and began the development of collaborative R&D initiatives in the five areas of: ocean research; artificial intelligence; advanced manufacturing; protein industries; and digital technology. The NRC is supporting these initiatives by enabling access to NRC research facilities, scientific and technical resources, project assessment services, and advice on intellectual property.

The NRC formed the Digital Technologies Program in early 2018, which will support the Digital Technology Supercluster.[xiii] The program explores the use of data and information in innovative and meaningful ways, in areas such as: virtual and augmented reality; artificial intelligence; machine learning; and healthcare platforms, with a goal to make digital technologies smarter and more intuitive for Canadians. The 2018-19 evaluation of the Digital Technologies Program found that activities were successful in contributing to the advancement of the field, especially in the areas of machine translation, sentiment analysis, and computer vision and graphics. Recommendations from the evaluation were addressed in 2018-19 and included among others, the development of a strategic plan, the launch of a reimagining initiative and the creation and staffing of a Chief Digital Research Officer, to lead the work being done in digital technologies.

Using new ongoing funding from Budget 2018, the NRC began the design of four large-scale collaborative R&D initiatives in the areas of: engineered gene and cell therapy; artificial intelligence assisted design; novel materials for clean fuels; and high throughput and secure networks. The seven-year programs were developed in consultation with academia, non-profit and industry stakeholders.

- High-throughput and Secure Networks Challenge program:[xiv] The program aims to develop electronic and photonic devices to enable implementation of next-generation, high-speed telecommunications networks that will offer secure, affordable broadband services in rural and remote communities in Canada beyond current high-speed internet standards. In 2018-19, the NRC contributed $1.5M to support investments in

foundational equipment by the University of Ottawa for the development of next-generation materials deposition and characterization for electronic photonic devices.

- Disruptive Technology Solutions for Cell and Gene Therapy Challenge program:[xv] The collaborative research program aims to develop affordable cell and gene therapies to Canadians for diseases of critical importance. In 2018-19, the NRC contributed $4.5M to investments in foundational equipment by Concordia University, Centre Hospitalier Universitaire Sainte-Justine and the University of Toronto, including the development of an automation platform for reprogramming of mammalian cells, equipment to enhance analytic capabilities of immune, cancer and stem cells, and equipment to increase the capacity of microfluidic device design.
- Materials for Clean Fuels Challenge program:[xvi] The program aims to fill technology gaps to meet Canada's long-term greenhouse gas emissions reduction commitments, by catalyzing the discovery and development of materials for early-stage exploratory technologies to decarbonize Canada's oil & gas and petrochemical sectors. In 2018-19, the NRC contributed $1M in support of foundational equipment investments by the University of Toronto to extend capabilities in green energy materials research including computational design, and synthesis and characterization of novel and emerging green energy materials.
- Artificial Intelligence for Design Challenge program (AI for Design):[xvii] In support of the other three Challenge Programs, the multi-party, collaborative research program will aim to develop a foundation of AI tools, technologies and capabilities to support accelerated clean energy materials discovery, the design of new photonics components, and contribute to disruptive technology solutions for cell and gene therapies.

In the 2018 Fall Economic Update,[xviii] the Government of Canada announced funding of $67.5M over five years to make the National Building, Fire, and Plumbing Codes and Energy Code for Buildings, as well as the Provincial Codes produced and distributed by the NRC, freely accessible electronically on the NRC's website, which was effective as of April 1st, 2019.[2]

In support of Canada's action on climate change, the NRC expanded its research efforts in advancing the energy efficiency of buildings. In 2018-19, the NRC:

- Began development of innovative building insulations using foams derived from renewable materials;
- Supported federal departments in monitoring and reporting energy use in over 80 buildings in the National Capital Region;

[2] As of June 2019, over 35,000 electronic copies of building codes have been accessed and the NRC has implemented a structure for collecting and reporting these statistics as well as a strategy to keep stakeholders and the public informed on the availability of building codes.

- Worked with Public Services and Procurement Canada and partners from academia and industry to develop guidelines for improving the energy efficiency of heritage buildings; and
- Published the National Energy Code for Buildings to support provinces and territories in setting current and future energy efficiency requirements for buildings.

Building on experimentation to apply technologies in innovative ways

NRC's Metrology Program developed new approaches to support high-integrity precision time using TimeLink™,[xix] a remote clock service that can maintain the official time for Canada with nanosecond synchronization to UTC (Coordinated Universal Time). The first client was the stock exchange company TMX, for use in highly demanding user requirements for time stamping financial transactions.

In 2018-19, the NRC further supported collaborative work in government priority areas.

- The 2018-19 evaluation of the Energy, Mining and Environment Program[xx] found that the program's work with Transport Canada to examine safe transportation of lithium-ion batteries has contributed to policy and regulations.
- The NRC launched a $4.9M project with the Government of Quebec and Université Laval to create a test to determine safe levels for pyrrhotite – an iron sulfide that can cause concrete to break down – and to identify the presence of pyrrhotite in Canadian quarries, as well as homes in Quebec with potentially compromised foundations. In 2018-19, an initial field survey of five damaged houses in Trois-Rivières was completed.
- The NRC continued to advance the Federal Arctic and Northern Policy Framework through engagement with other government departments. In alignment with government priorities for Canada's North, the NRC signed agreements with Polar Knowledge Canada and Canada-Newfoundland & Labrador Offshore Petroleum Board (C-NLOPB) to enable access to NRC research. Research projects were conducted with partners across Indigenous corporations, industry and academia to improve the quality of life in the North, in areas such as sewage treatment technology, improved indoor air quality, and safer marine transportation.
- In 2018-19, the ground-breaking Centre for Air Travel Research was opened as a facility where large aircraft manufacturers and air carriers concerned about the comfort and safety of passengers can conduct unique research. The Centre's unique facilities include five laboratories for simulating the passenger experience and a Flexible Cabin Laboratory. The NRC also enabled the development of a regulatory emissions standard for non-volatile Particle Matter, the culmination of nine years of work, which will result in significant reductions in new aircraft engine emissions.

- The NRC contributed to a Health Canada white paper outlining best practices for cyber-testing medical software, taking into account patient security, rapid innovation in the industry and the use of artificial intelligence in healthcare.
- The NRC is leading efforts in the development of normative standards for cannabis processing at the international level. The NRC is also working with Justice Canada and Public Safety Canada to develop technologies for the processing and testing of cannabis products in order to implement an evaluation protocol of roadside drug detection devices.

The NRC also made significant strides in the areas of nanotechnology and quantum photonics in 2018-19. With support from the Canadian Space Agency, the NRC developed an on-chip quantum light source platform based on semiconductor quantum dots embedded in photonic nanowires and integrated with silicone-based photonic circuits. This platform offers a scalable solution in many applications of quantum information processing and paves the way toward self-contained, all-fibre, plug-and-play applications.

The NRC contributed to research to understand the quantum-photonic behaviour of double-bonded chains, which act as the tiniest "sensors" in biology, such as the visual sensor rhodopsin in the eye that registers light and tells the brain something has been seen. Combining state-of-the-art ultrafast laser experiments with quantum dynamics simulations to explain how butadiene converts light into energy, NRC researchers helped solve the 30-year old mystery of the "missing link" that carries the potential to unlock research and new applications in artificial vision, plastic electronics and new photovoltaic[3] technologies.

[3] Photovoltaics are a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons by the photovoltaic effect. Solar cells produce direct current electricity from sunlight which can be used to power equipment or to recharge a battery.

Results achieved

Departmental Result Indicators	Targets[1]	Date to achieve target	2018–19 Actual results	2017–18 Actual results	2016–17 Actual results
Departmental Result 1: Scientific and technological knowledge advances					
Citation score of NRC-generated publications relative to the world average[2]	Greater than 1.50	March 31, 2019	1.51	1.45	1.53
Number of unique intellectual assets (patents, disclosures, publications) generated by NRC research leaders[3]	1,140	March 31, 2019	1,153	1,099	1,216
Percentage[4] of the NRC workforce made up of underrepresented groups relative to Canadian average labour market availability in Science, Technology, Engineering, and Mathematics (STEM)[5]	1.0	March 31, 2019	1.02	0.98	0.99
Departmental Result 2: Innovative businesses grow					
Percentage revenue growth of firms engaged with NRC (research and development-engaged firms)[6]	N/A	N/A	N/A	N/A	N/A
Percentage revenue growth of firms engaged with NRC (IRAP-engaged firms)[7]	Greater than 25%	March 31, 2019	27%	25%	26%
Percentage growth in Canada's S&T related jobs through NRC supported firms (research and development-engaged firms)[6]	N/A	N/A	N/A	N/A	N/A
Percentage growth in Canada's S&T related jobs through NRC supported firms (IRAP-engaged firms)[7]	Greater than 12%	March 31, 2019	18%	13%	11%
Firm investment in NRC research and development services and scientific and technological infrastructure	Greater than $80M annually	March 31,2019	$79.7M	$87.0M	$82.5M
Departmental Result 3: Evidence-based solutions inform decisions in Government priority areas					
NRC investment in collaborative work with other federal government departments in Government priority areas	Greater than $70M annually	March 31, 2019	$93.1M	$82.4M	$74.9M
Number of scientific and other publications (e.g., technical papers, committee proceedings, reports) generated by NRC research leaders in Government priority areas[8]	1,640	March 31, 2019	1,279	1,235	1,441

[1] The targets for 2018-19 are based on a general increase in performance trend since 2014-15.
[2] Field-Weighted Citation Impact Score (FWCI) measured over a period of three calendar years. Based on NRC peer-reviewed publications indexed in Scopus as of May 2019.
[3] Based on NRC peer reviewed publications indexed in Scopus as of May 2019. Sum of patents, disclosures, publications and trade secrets generated by NRC activities.
[4] The indicator was changed in 2019-20 from percentage to ratio of the NRC workforce.
[5] The indicator is focused on the workforce representation of women up to FY-end 2019-20. Results are based on 2011 census data.
[6] Indicators/methodologies were reviewed and replaced by an indicator on the percentage of R&D clients who report positive benefits (e.g., increase in jobs, sales, R&D expenditures or other) of working with the NRC. This new indicator was established in 2018-19 with a target set of 86% for 2019-20 Departmental Plan reporting purposes.
[7] Measured over a period of three calendar years and lagging by two years by nature of the measurement methodology.
[8] Scopus database allows tagging to multiple research areas, thus the number of publications by priority area could be larger than the total number of publications generated by the organization. Based on NRC peer reviewed publications indexed in Scopus as of May 2019.

Budgetary financial resources (dollars)

2018–19 Main Estimates	2018–19 Planned spending	2018–19 Total authorities available for use	2018–19 Actual spending (authorities used)	2018–19 Difference (Actual spending minus Planned spending)
907,545,876	917,284,562	1,279,501,878	992,172,039	74,887,477

Human resources (full-time equivalents)

2018–19 Planned full-time equivalents	2018–19 Actual full-time equivalents	2018–19 Difference (Actual full-time equivalents minus Planned full-time equivalents)
2,560.0	3,062.6	502.6

Explanation of the increase in 2018-19 actual FTEs compared to planned FTEs, as well as year over year variances are provided on page 29.

Financial, human resources and performance information for the NRC's Program Inventory is available in the GC InfoBase.[xxi]

Internal Services

Description

Internal Services are those groups of related activities and resources that the federal government considers to be services in support of programs and/or required to meet corporate obligations of an organization. Internal Services refers to the activities and resources of the 10 distinct service categories that support Program delivery in the organization, regardless of the Internal Services delivery model in a department. The 10 service categories are:

- Acquisition Management
- Communications Services
- Financial Management
- Human Resources Management
- Information Management
- Information Technology Management
- Legal Services
- Materiel Management
- Management and Oversight
- Real Property Management

Results

In 2018-19, improvements to the NRC's internal services were guided by NRC Dialogue[vii] action plans, bringing the organization one step closer to making its vision of a "re-imagined NRC" a reality. Achievements and progress so far were celebrated at a "stock-taking" summit with stakeholders in June 2018 and the "Path Forward on the Action Plan" was laid out in November 2018 to set the stage for future plans. At the end of 2018-19, 77 percent of Dialogue actions had been completed[4].

Building on the results of the NRC Dialogue, several key corporate initiatives were undertaken in 2018-19 to support the effective management and strategic positioning of the NRC.

- The NRC developed a five-year Strategic Plan to enhance its role in Canada's innovation landscape, reinforce research strengths, and better position the organization for collaboration with government, industry and academia. The following five overarching areas of strategic focus were identified: 1) enabling a more sustainable economy; 2) supporting a healthier future; 3) innovating the everyday; 4) creating Canadian wealth through innovation; and 5) understanding our world.
- As a companion to the Strategic Plan, the NRC also developed a Strategic Human Resources Plan. The Strategic Human Resources Plan outlines a number of new

[4] As of June 2019, 85 percent of Dialogue actions had been completed.

initiatives to enhance the NRC's ability to attract, develop and retain a diverse, talented, healthy and engaged workforce, including a Leadership Development Framework, an Equity, Diversity and Inclusion Strategy, a Wellness Strategy and STEM Continuum Framework.

- Inspired by Canada's Chief Science Advisor, the NRC developed and launched its new Research and Scientific Integrity Policy. The policy, championed by the NRC's Departmental Science Advisor and Chief Science Officer, demonstrates the NRC's commitment to the highest standards for research and science and supports the ability of NRC employees to speak freely about their work while ensuring public trust in NRC research and science.
- A review of internal services was done to identify potential gaps and areas for improvements, such as:
    - a review of the investment management process with a focus on governance, process efficiency, and pro-active monitoring;
    - the implementation of the SAP travel module, to improve travel reimbursement turnaround and travel approval processes; and
    - establishment of a client advisory board and completion of an extensive review of the service delivery models for employee onboarding and procurement, resulting in over 40 recommendations that align with the NRC's business needs and research requirements. Security and travel will be reviewed in 2019-20 using a similar approach and the development of a comprehensive service catalogue is scheduled to take place over the next two years.
- To better support its workforce, the NRC upgraded existing high performance computing capabilities, secured legacy infrastructure, stabilized email services, implemented mobile tools and invested in new capabilities for the Artificial Intelligence for Design and Quantum programs. These activities were carried out in response to internal needs as well as a recommendation from the 2018-19 evaluation of the Digital Technologies Program.[xxii]
- The NRC is developing and modernizing its facilities as an active partner in the Federal Science and Technology Infrastructure Initiative (now named Laboratories Canada Initiative). Newly built or renovated labs will incorporate sustainable features to bring federal scientists together for collaborative research. The NRC is the co-lead on two of the five clusters[5]: Terra Canada and Transportation Safety, and is a partner in two others: Regulatory and Security Science, and the Atlantic Science Enterprise Centre.

[5] A cluster in the context of the Federal Science and Technology Infrastructure Initiative refers to a group of federal organizations working on a common set of science themes.

- Development of a three-year strategy to revitalize the NRC's buildings and real estate continues, including an on-going review of key facilities to determine which buildings need to be maintained, renovated, repurposed, disposed or rebuilt based on R&D program requirements.
- The NRC continued to strengthen its business processes to ensure sound environmental stewardship and further its understanding of compliance obligations related to its operations, by advancing the implementation of its organization-wide Environmental Management System (EMS). Year three of the four-year Contaminated Sites Work Program[xxiii] was completed, including assessment and risk management actions consistent with the Federal Approach to Contaminated Sites and the precautionary principle. These actions led to closure of two contaminated site files in 2018-19, bringing the total closed files to 14 out of 22.

In 2018-19, the NRC continued building a skilled Canadian workforce that is strong, sustainable, inclusive and diverse.

Building on experimentation to apply technologies in innovative ways

As part of an on-going experimentation initiative to provide more timely delivery of information to the public, NRC IRAP successfully finalized the development of public blockchain prototype[xxiv] in proactive disclosure of contract agreements. With the goal of applying the technology to other applications at the NRC and facilitating its adoption across the Government of Canada, the application had more than 162,000 unique visitors from over 200 countries worldwide.

- A new Equity, Diversity and Inclusion (EDI) committee was launched, a comprehensive three-year EDI Strategy was developed, and a preferred hiring approach for Employment Equity (EE) designated groups for student recruitment was implemented. Mandatory training in diversity, inclusion and unconscious bias for all staff and managing bias for hiring managers was implemented and diversity objectives were added as part of performance agreements for managers.
- The NRC implemented a Recruitment and Retention of Women Strategy. As part of the strategy, the NRC participated in an Engendering Success in STEM research consortium led by the University of British Columbia and funded by the Social Sciences and Humanities Research Council (SSHRC); and, a series of networking events, panels and workshops on women in science were organized in collaboration with national and international partners.
- As part of the federal Women Entrepreneurship Strategy, NRC IRAP established a strategy for increasing the representation and success of firms led by underrepresented groups.
- The NRC participated in several notable events over the course of the year, including:

  - Vice-President of Emerging Technologies Geneviève Tanguay took part in a science policy panel on International Day of Girls and Women, with Canada's Chief Science Advisor, Dr. Mona Nemer and Her Excellency the Right Honourable Julie Payette, Governor General of Canada; and
  - A global networking event "Empowering Women in Chemistry"[xxv] in collaboration with the Canadian National Committee for IUPAC (International Union of Pure & Applied Chemistry).

- The NRC is a key training ground for Canada's next generation of researchers and innovators and gives promising scientists the chance to work on projects of critical importance to Canada. In 2018-19, 12 new post-doctoral fellows were added to the Post-Doctoral Fellowship program bringing the total to 24 chosen from a pool of 614 applicants. The NRC also exceeded its student placement target for the year, creating 393 opportunities for undergraduate and master's level students and hiring 21 PhD research associates.
- In support of the NRC's ongoing commitment to ensure a safe, healthy and respectful workplace, the NRC created and staffed the first Ombudsperson, Ethics, Integrity and Respectful Workplace, and Informal Conflict Resolution Practitioner positions in order to help all employees prevent and resolve conflicts, feel safe bringing forward issues and complaints and navigate the often complex processes.

Budgetary financial resources (dollars)

2018–19 Main Estimates	2018–19 Planned spending	2018–19 Total authorities available for use	2018–19 Actual spending (authorities used)	2018–19 Difference (Actual spending minus Planned spending)
119,473,705	122,587,640	166,326,374	153,031,813	30,444,173

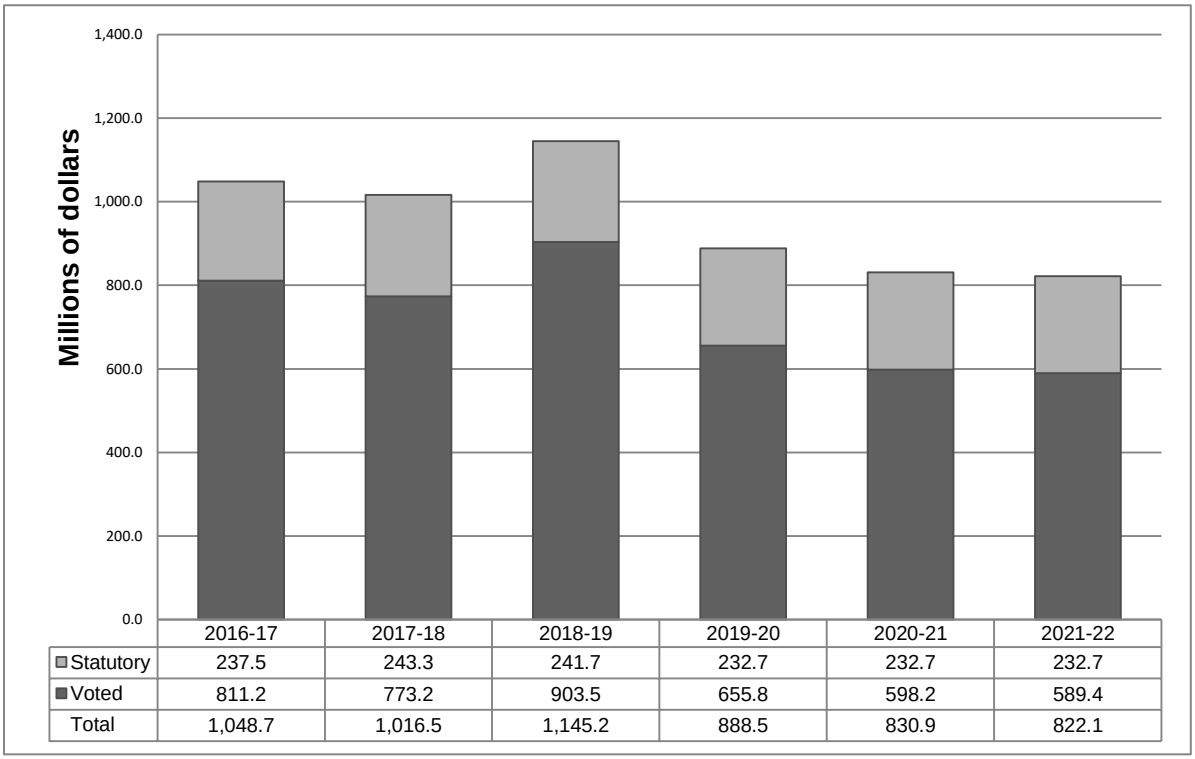
Human resources (full-time equivalents)

2018–19 Planned full-time equivalents	2018–19 Actual full-time equivalents	2018–19 Difference (Actual full-time equivalents minus Planned full-time equivalents)
883.9	887.6	3.7

Analysis of trends in spending and human resources

Actual expenditures

Departmental spending trend graph



	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Statutory	237.5	243.3	241.7	232.7	232.7	232.7
Voted	811.2	773.2	903.5	655.8	598.2	589.4
Total	1,048.7	1,016.5	1,145.2	888.5	830.9	822.1

The NRC's actual spending trend over the last three years has increased, with spending of $1,145.2M in 2018-19, representing growth of $128.7M from the $1,016.5M spent in 2017-18. This increase is largely associated with permanent funding provided by the 2018 Federal Budget. Most significantly, Budget 2018 provided NRC IRAP with an additional $100M in 2018-19, of which $90.0M was received for grants and contributions. Secondly, Budget 2018 provided funding for a new Collaborative Science, Technology and Innovation (CSTI) Program which spent $9.1M in grants and contributions in 2018-19. Other increases that contributed to the 2018-19 spending variance include the rising cost of salaries and contributions paid under the International Astronomical Observatories Program. Specifically:

- salary expenditures, not including employee benefit costs, increased by $26.7M in 2018-19 as a result of renewed collective agreements, of which $8.6M of the variance relates to one-time expenditures for retroactive payroll liabilities, and
- contributions for international telescopes increased by $5.8M in 2018-19, due to Canada's participation in the Thirty Meter Telescope (TMT).

The following variance explanations provide additional details between 2018-19 plans to actuals and year-over-year results.

Actual spending of $1,145.2M in 2018-19 in comparison to planned spending of $1,039.9M represents an overall increase of $105.3M (10.1 percent). The variance from 2018-19 plans is attributable to expenditure increases of $104.4M in operating and $8.6M in statutory spending, offset by decreases of $6.5M in grants and contributions and $1.3M in capital expenditures. The most significant cause of increased spending in operating results from the permanent funding received from Budget 2018 to stabilize operations at the NRC ($59.6M), to support NRC IRAP and CSTI ($10.3M), to support reduced fees ($12.4M) and funding related to the signature of collective bargaining agreement ($20.7M). The decrease of $6.5M in grants and contributions resulted mainly from a $111.6M funding reprofile from 2018-19 to future years to account for project delays associated with Canada's participation in the TMT construction, offset by increases of $90.0M for NRC IRAP Contributions to Firms and $9.1M for CSTI, which were announced in Budget 2018. All Budget 2018 funding was accessed through the 2018 Budget Implementation Vote and was not included in the 2018-19 Planned Spending.

Overall, year over year fluctuations within the NRC's actual spending largely results from transfer payment programs and operational costs. The following table summarizes 2018-19 spending and year-over-year variances.

in millions of dollars	2018-19 Spending	Variance from 2017-18	Variance from 2016-17
NRC IRAP – Firms and Organizations	258.3	88.5	30.3
NRC IRAP - Canada Accelerator and Incubator Program	18.0	(6.0)	(6.3)
International Astronomical Observatories Program	27.7	5.8	6.7
TRIUMF	57.3	2.7	3.6
Collaborative Science, Technology and Innovation Program	9.1	9.1	9.1
NRC IRAP - Youth Employment Strategy	17.1	(5.4)	2.2
All other	1.7	0.5	0.5
Grants and Contributions	**389.2**	**95.2**	**46.1**
Federal Infrastructure Initiative	30.8	(8.1)	(8.4)
All other	30.9	0.2	0.2
Capital	**61.7**	**(7.9)**	**(8.2)**
Operating	**452.5**	**42.9**	**54.5**
Statutory Revenue	**182.0**	**(8.9)**	**(0.7)**
Other Statutory (i.e. Employee Benefits)	**59.8**	**7.4**	**4.8**
Total Expenditures	**1,145.2**	**128.7**	**96.5**

Budgetary performance summary for Core Responsibility and Internal Services (dollars)

Core Responsibility and Internal Services	2018–19 Main Estimates	2018–19 Planned spending	2019–20 Planned spending	2020–21 Planned spending	2018–19 Total authorities available for use	2018–19 Actual spending (authorities used)	2017–18 Actual spending (authorities used)	2016–17 Actual spending (authorities used)
Science and Innovation	907,545,876	917,284,562	772,512,495	714,833,977	1,279,501,878	992,172,039	787,453,668	808,753,764
Internal Services	119,473,705	122,587,640	116,002,531	116,085,149	166,326,374	153,031,813	229,069,769	239,986,701
Total	1,027,019,581	1,039,872,202	888,515,026	830,919,126	1,445,828,252	1,145,203,852	1,016,523,437	1,048,740,465

Expenses and FTEs related to National Science Library, Research Information Technology Platforms and Special Purpose Real Property were not reallocated to the Science and Innovation Core Responsibility for 2016-17 and 2017-18 because the reporting structure was not in place to allow the NRC to report on the Departmental Results Framework and Program Inventory of record for 2018-19.

Actual human resources

Human resources summary for Core Responsibility and Internal Services (full-time equivalents)

Core Responsibility and Internal Services	2016–17 Actual full-time equivalents	2017–18 Actual full-time equivalents	2018–19 Planned full-time equivalents	2018–19 Actual full-time equivalents	2019–20 Planned full-time equivalents	2020–21 Planned full-time equivalents
Science and Innovation	2,924.7	2,997.3	2,560.0	3,062.6	2,535.3	2,535.3
Internal Services	945.7	981.9	883.9	887.6	883.9	883.9
Total	3,870.4	3,979.2	3,443.9	3,950.2	3,419.2	3,419.2

Expenses and FTEs related to National Science Library, Research Information Technology Platforms and Special Purpose Real Property were not reallocated to the Science and Innovation Core Responsibility for 2016-17 and 2017-18 because the reporting structure was not in place to allow the NRC to report on the Departmental Results Framework and Program Inventory of record for 2018-19.

The NRC’s actual 2018-19 FTEs (3,950.2) has remained stable when compared to the 2017-18 FTE level (3,979.2), representing a slight decrease of 29 FTEs (< 1 percent).

The NRC’s actual FTEs increased when compared to 2018-19 planned FTEs (3,443.9). The increase in FTEs is mainly attributable to funding received in Budget 2018 that was previously

provided on a temporary basis, such as the funding to sustain operations at the NRC. Budget 2018 funding was accessed through the 2018 Budget Implementation Vote and was not included in the 2018-19 Planned FTEs.

The following table summarizes the 2018-19 FTE levels and year over year variances.

Description	2018-19 FTEs	Variance from 2017-18	Variance from 2016-17
Research and Development FTEs	2,400.0	(8.3)	44.6
Industrial Research Assistance Program FTEs	397.6	10.3	28.2
Internal Services and Enabling Services FTEs	1,152.6	(31.0)	7.0
Total NRC FTEs	**3,950.2**	**(29.0)**	**79.8**

Expenditures by vote

For information on the NRC's organizational voted and statutory expenditures, consult the Public Accounts of Canada 2018–2019.[xxvi]

Government of Canada spending and activities

Information on the alignment of the NRC's spending with the Government of Canada's spending and activities is available in the GC InfoBase.[xxi]

Financial statements and financial statements highlights

Financial statements

The NRC's financial statements (audited) for the year ended March 31, 2019, are available on the NRC's website.[xxvii]

Financial statements highlights

Condensed Statement of Operations (audited) for the year ended March 31, 2019 (dollars)

Financial information	2018–19 Planned results	2018–19 Actual results	2017–18 Actual results	Difference (2018–19 Actual results minus 2018–19 Planned results)	Difference (2018–19 Actual results minus 2017–18 Actual results)
Total expenses	986,870,000	1,123,688,000	1,044,860,000	136,818,000	78,828,000
Total revenues	202,100,000	198,185,000	221,352,000	(3,915,000)	(23,167,000)
Net cost of operations before government funding and transfers	784,770,000	925,503,000	823,508,000	140,733,000	101,995,000

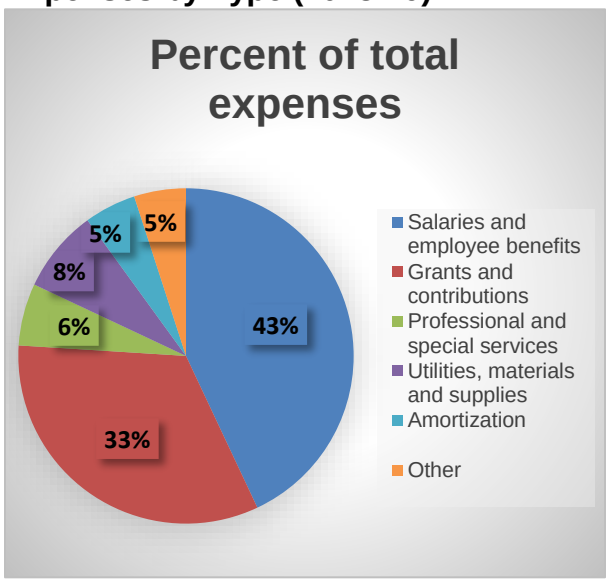
The NRC's consolidated financial statements include both the NRC and its portion of the accounts of the Canada-France-Hawaii Telescope Corporation (CFHT) and TMT International Observatory LLC (TIO). The NRC relationship with CFHT and TIO meets the definition of a government partnership under Canadian public sector accounting standards, which requires that its results be proportionally consolidated within those of the NRC. All inter-organizational balances and transactions are eliminated as part of the consolidation process. CHFT and TIO statements as at December 31, 2018 have been proportionally consolidated with NRC's March 31 accounts.

The NRC's consolidated total expenses of $1,124M in 2018-19 represent an increase from $1,045M in 2017-18. The NRC's major expense components are salaries and employee benefits ($479M) and grants and contributions ($368M), representing 75 percent of total expenses. The $79M increase is primarily due to an increase in grants and contributions of $87M, an increase in salary and benefits of $13M mainly due to renewed collective agreements and ongoing collective bargaining and a decrease of $21M in professional services. Most of the other expense categories appearing in the consolidated financial statements were stable in comparison to 2017-18. The planned expenses, as reported in the NRC's Consolidated Future Oriented Financial Statements in the 2018-19 Departmental Plan were $987M. The variance between planned and actual results of $137M is primarily due to an increase in grants and contributions of $110M, an increase in utilities, materials and supplies of $18M, and an increase in amortization of $5M.

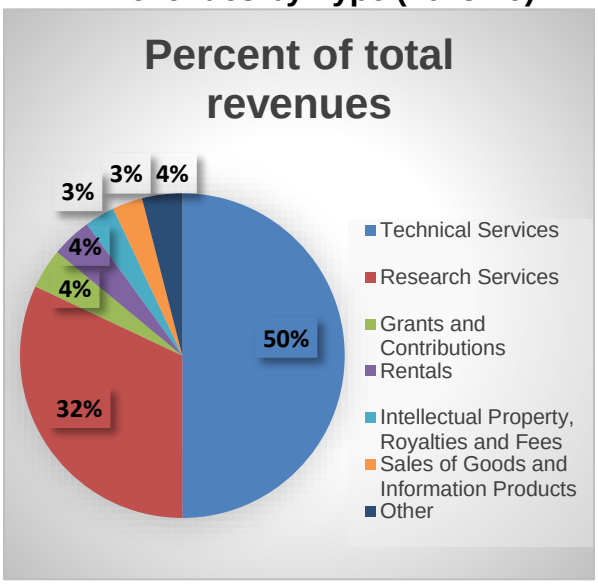
The NRC generates revenue which can be reinvested in operations. The NRC's consolidated total revenues of $198M in 2018-19 represent a decrease from $221M in 2017-18. The NRC's major revenue components were Research Services ($64M) and Technical Services ($99M), representing 82 percent of revenues. The planned revenue, as reported in the NRC's

Consolidated Future Oriented Financial Statements in the 2018-19 Departmental Plan was $202M. The total variance of $4M is largely attributed to Grants and Contributions ($11M lower than the planned results) and Research Services ($7M higher than the planned results).

Expenses by Type (2018-19)



Revenues by Type (2018-19)



Condensed Statement of Financial Position (audited) as of March 31, 2019 (dollars)

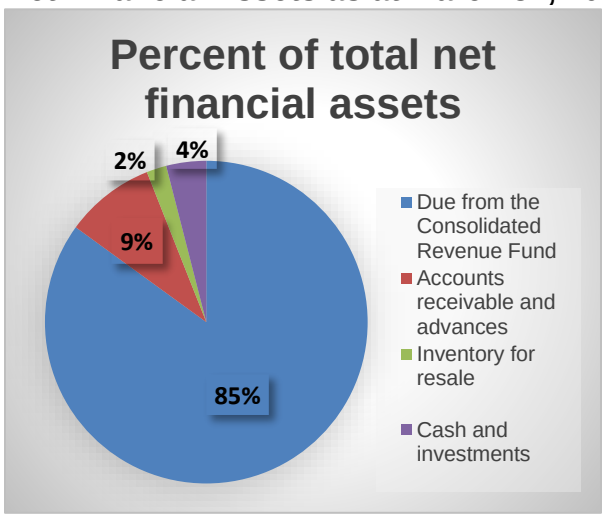
Financial Information	2018–19	2017–18	Difference (2018–19 minus 2017–18)
Total net liabilities	344,513,000	313,501,000	31,012,000
Total net financial assets	392,785,000	363,419,000	29,366,000
Departmental net financial assets	48,272,000	49,918,000	(1,646,000)
Total non-financial assets	692,314,000	654,245,000	38,069,000
Departmental net financial position	740,586,000	704,163,000	36,423,000

The NRC's consolidated net financial assets totalled $393M as at March 31, 2019, an increase of $30M from the March 31, 2018 balance of $363M. The balance is made up of the Due from the Consolidated Revenue Fund (CRF), accounts receivable, inventory for resale and cash and investments. The increase is primarily due to a $30M increase of the Due from the CRF.

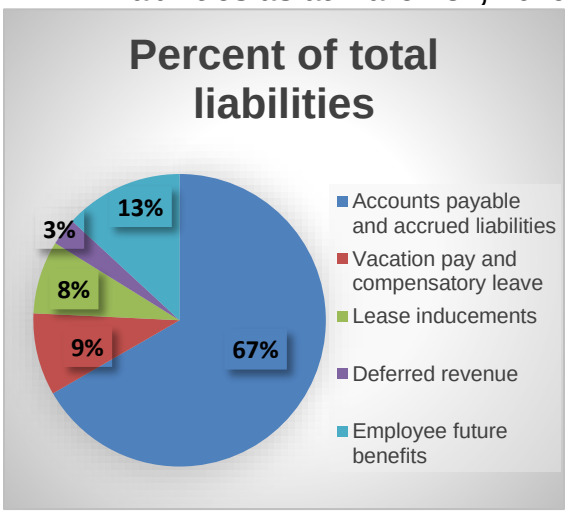
The NRC's consolidated liabilities consist of accounts payable and accrued liabilities, vacation and compensatory leave, lease inducements, deferred revenues, lease obligations for tangible capital assets and employee future benefits. The balance as at March 31, 2019 of $345M represents a $31M decrease from the March 31, 2018 balance of $314M (restated). The decrease

is primarily due to a $32M increase in accounts payable and accrued liabilities payable to external parties.

Net Financial Assets as at March 31, 2019



Liabilities as at March 31, 2019



Supplementary information

Corporate information

Organizational profile

Appropriate ministers:

The Honourable Navdeep Bains, P.C., M.P., Minister of Innovation, Science and Economic Development; and

The Honourable Kirsty Duncan, P.C., M.P., Minister of Science and Sport

Institutional head: Mr. Iain Stewart, President

Ministerial portfolio: Innovation, Science and Economic Development

Enabling instrument: *National Research Council Act*,[v] R.S.C. 1985, c. N-15

Year of incorporation / commencement: 1916

Other: The NRC is a departmental corporation of the Government of Canada, reporting to Parliament through the Minister of Innovation, Science and Economic Development in collaboration with the Minister of Science and Sport. The NRC works in partnership with members of the Innovation, Science and Economic Development Portfolio to leverage complementary resources to promote science and research and integrated innovation, to exploit synergies in key areas of science and technology, to promote the growth of small and medium-sized enterprises and to contribute to Canadian economic growth. The NRC's Council provides independent strategic advice to the NRC President and it reviews organizational performance. The President provides leadership and strategic management and is responsible for the achievement of the NRC's long-range goals and plans in alignment with government priorities as reflected in his mandate letter. Each of the NRC's Vice-Presidents is responsible for a number of areas composed of programs and research initiatives, centres, the Industrial Research Assistance Program, and/or a corporate branch. Vice-Presidents and NRC managers are responsible for executing plans and priorities to ensure successful achievement of objectives.

Raison d'être, mandate and role: who we are and what we do

"Raison d'être, mandate and role: who we are and what we do" is available on the NRC's website.[xxvii]

For more information on the department's organizational mandate letter commitments, see the Ministers' mandate letters.[xxviii]

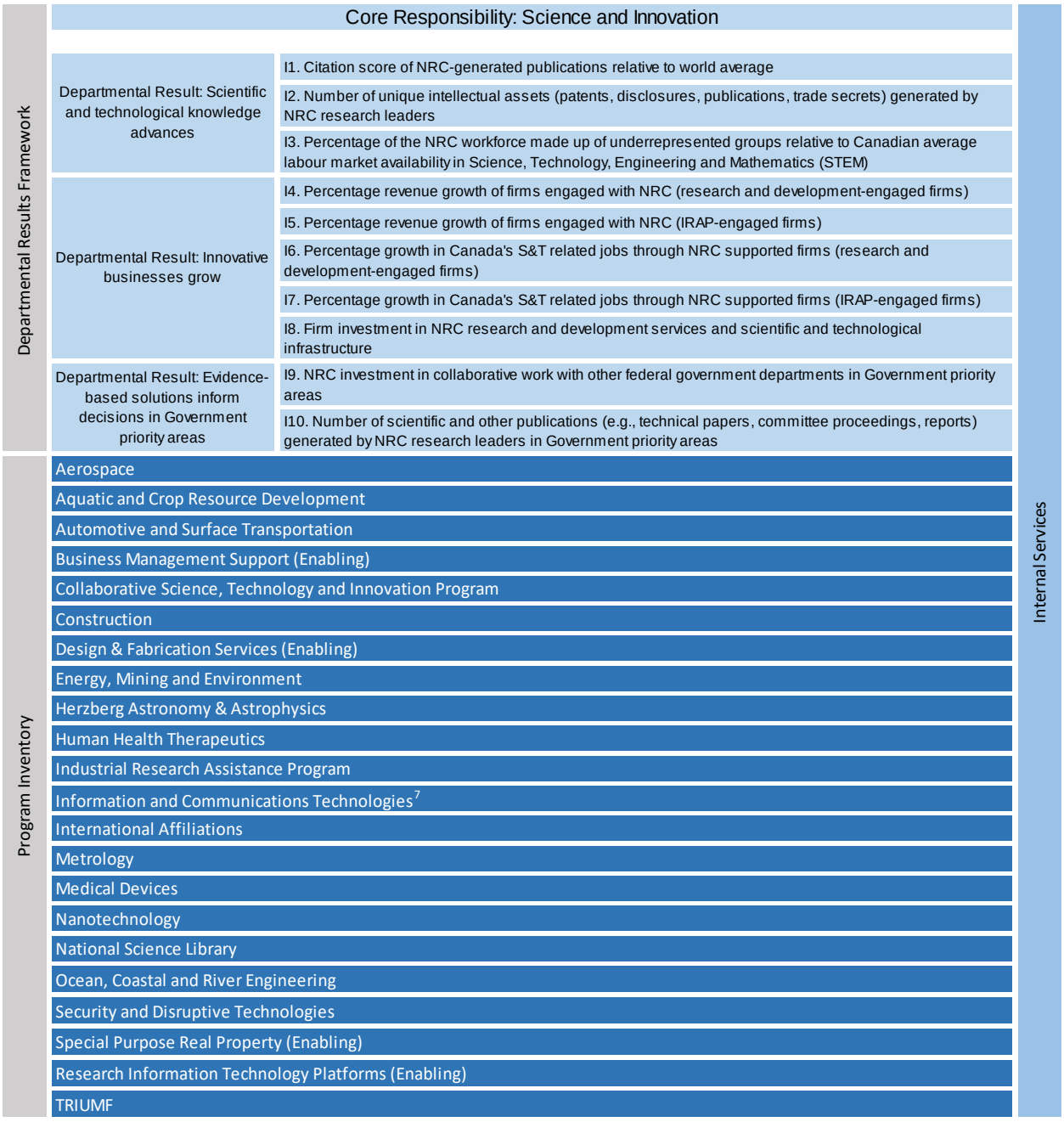
Operating context and key risks

Information on operating context and key risks is available on the NRC's website.[xxvii]

Reporting framework

The NRC's Departmental Results Framework and Program Inventory of record for 2018–19 are shown below.[6]

Graphical presentation of Departmental Results Framework and Program Inventory



[6] See GC InfoBase[xxi] for the full names and descriptions of the Departmental Results Indicators in the NRC's Departmental Results Framework.

[7] The activities of the Information and Communications Technologies Program were split into the "Advanced Electronics and Photonics" and "Digital Technologies" Programs in 2018-19. The two programs are referenced throughout the main document and focus on separate areas of R&D.

Supporting information on the Program Inventory

Financial, human resources and performance information for the NRC's Program Inventory is available in the GC InfoBase.[xxi]

Supplementary information tables

The following supplementary information tables are available on the NRC's website:[xxvii]

- Departmental Sustainable Development Strategy
- Details on transfer payment programs of $5 million or more
- Gender-based analysis plus
- Horizontal initiatives
- Response to parliamentary committees and external audits

Federal tax expenditures

The tax system can be used to achieve public policy objectives through the application of special measures such as low tax rates, exemptions, deductions, deferrals and credits. The Department of Finance Canada publishes cost estimates and projections for these measures each year in the Report on Federal Tax Expenditures.[xxix] This report also provides detailed background information on tax expenditures, including descriptions, objectives, historical information and references to related federal spending programs. The tax measures presented in this report are the responsibility of the Minister of Finance.

Organizational contact information

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Appendix: definitions

appropriation (crédit)

Any authority of Parliament to pay money out of the Consolidated Revenue Fund.

budgetary expenditures (dépenses budgétaires)

Operating and capital expenditures; transfer payments to other levels of government, organizations or individuals; and payments to Crown corporations.

Core Responsibility (responsabilité essentielle)

An enduring function or role performed by a department. The intentions of the department with respect to a Core Responsibility are reflected in one or more related Departmental Results that the department seeks to contribute to or influence.

Departmental Plan (plan ministériel)

A report on the plans and expected performance of an appropriated department over a three-year period. Departmental Plans are tabled in Parliament each spring.

Departmental Result (résultat ministériel)

A Departmental Result represents the change or changes that the department seeks to influence. A Departmental Result is often outside departments' immediate control, but it should be influenced by program-level outcomes.

Departmental Result Indicator (indicateur de résultat ministériel)

A factor or variable that provides a valid and reliable means to measure or describe progress on a Departmental Result.

Departmental Results Framework (cadre ministériel des résultats)

Consists of the department's Core Responsibilities, Departmental Results and Departmental Result Indicators.

Departmental Results Report (rapport sur les résultats ministériels)

A report on an appropriated department's actual accomplishments against the plans, priorities and expected results set out in the corresponding Departmental Plan.

experimentation (expérimentation)

Activities that seek to explore, test and compare the effects and impacts of policies, interventions and approaches, to inform evidence-based decision-making, by learning what works and what does not.

full-time equivalent (équivalent temps plein)

A measure of the extent to which an employee represents a full person-year charge against a departmental budget. Full-time equivalents are calculated as a ratio of assigned hours of work to scheduled hours of work. Scheduled hours of work are set out in collective agreements.

gender-based analysis plus (GBA+) (analyse comparative entre les sexes plus [ACS+])

An analytical process used to help identify the potential impacts of policies, Programs and services on diverse groups of women, men and gender differences. We all have multiple identity factors that intersect to make us who we are; GBA+ considers many other identity factors, such as race, ethnicity, religion, age, and mental or physical disability.

government-wide priorities (priorités pangouvernementales)

For the purpose of the 2018–19 Departmental Results Report, those high-level themes outlining the government's agenda in the 2015 Speech from the Throne, namely: Growth for the Middle Class; Open and Transparent Government; A Clean Environment and a Strong Economy; Diversity is Canada's Strength; and Security and Opportunity.

horizontal initiative (initiative horizontale)

An initiative where two or more departments are given funding to pursue a shared outcome, often linked to a government priority.

non-budgetary expenditures (dépenses non budgétaires)

Net outlays and receipts related to loans, investments and advances, which change the composition of the financial assets of the Government of Canada.

performance (rendement)

What an organization did with its resources to achieve its results, how well those results compare to what the organization intended to achieve, and how well lessons learned have been identified.

performance indicator (indicateur de rendement)

A qualitative or quantitative means of measuring an output or outcome, with the intention of gauging the performance of an organization, program, policy or initiative respecting expected results.

performance reporting (production de rapports sur le rendement)

The process of communicating evidence-based performance information. Performance reporting supports decision making, accountability and transparency.

plan (plan)
The articulation of strategic choices, which provides information on how an organization intends to achieve its priorities and associated results. Generally a plan will explain the logic behind the strategies chosen and tend to focus on actions that lead up to the expected result.

planned spending (dépenses prévues)
For Departmental Plans and Departmental Results Reports, planned spending refers to those amounts presented in Main Estimates.

A department is expected to be aware of the authorities that it has sought and received. The determination of planned spending is a departmental responsibility, and departments must be able to defend the expenditure and accrual numbers presented in their Departmental Plans and Departmental Results Reports.

priority (priorité)
A plan or project that an organization has chosen to focus and report on during the planning period. Priorities represent the things that are most important or what must be done first to support the achievement of the desired Strategic Outcome(s) or Departmental Results.

program (programme)
Individual or groups of services, activities or combinations thereof that are managed together within the department and focus on a specific set of outputs, outcomes or service levels.

result (résultat)
An external consequence attributed, in part, to an organization, policy, program or initiative. Results are not within the control of a single organization, policy, program or initiative; instead they are within the area of the organization’s influence.

statutory expenditures (dépenses législatives)
Expenditures that Parliament has approved through legislation other than appropriation acts. The legislation sets out the purpose of the expenditures and the terms and conditions under which they may be made.

Strategic Outcome (résultat stratégique)
A long-term and enduring benefit to Canadians that is linked to the organization’s mandate, vision and core functions.

target (cible)
A measurable performance or success level that an organization, program or initiative plans to achieve within a specified time period. Targets can be either quantitative or qualitative.

voted expenditures (dépenses votées)

Expenditures that Parliament approves annually through an Appropriation Act. The Vote wording becomes the governing conditions under which these expenditures may be made.

Endnotes

i. Mandate Letters, https://pm.gc.ca/en/mandate-letters
ii. Challenge Missions, https://nrc.canada.ca/en/research-development/research-collaboration/programs/challenge-programs
iii. NRC President's Mandate Letter, https://nrc.canada.ca/en/corporate/about-nrc/mandate-letter-mr-iain-stewart-september-6-2018
iv. Innovation and Skills Plan, https://www.budget.gc.ca/2017/docs/themes/Innovation_en.pdf
v. *National Research Council Act*, https://laws-lois.justice.gc.ca/eng/acts/N-15/index.html
vi. Innovation Superclusters Initiative, https://www.ic.gc.ca/eic/site/093.nsf/eng/home
vii. NRC Dialogue, https://nrc.canada.ca/en/corporate/overview-nrc-dialogue
viii. Dominion Astrophysical Observatory, https://nrc.canada.ca/en/research-development/nrc-facilities/dominion-astrophysical-observatory-research-facility
ix. TRIUMF, http://www.triumf.ca/
x. Evaluation of TRIUMF, https://nrc.canada.ca/en/corporate/planning-reporting/evaluation-triumf
xi. Joint Centre for Extreme Photonics, http://extremephotonics.com/
xii. Gender-based Analysis Plus (GBA+), https://cfc-swc.gc.ca/gba-acs/index-en.html
xiii. Digital Technology Supercluster, https://www.ic.gc.ca/eic/site/093.nsf/eng/00011.html
xiv. High-throughput and Secure Networks Challenge program, https://nrc.canada.ca/en/research-development/research-collaboration/programs/high-throughput-secure-networks-challenge-program
xv. Disruptive Technology Solutions for Cell and Gene Therapy Challenge program, https://nrc.canada.ca/en/research-development/research-collaboration/programs/health-challenge-disruptive-technology-solutions-cell-gene-therapy-0
xvi. Materials for Clean Fuels Challenge program, https://nrc.canada.ca/en/research-development/research-collaboration/programs/materials-clean-fuels-challenge-program
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xviii. 2018 Fall Economic Statement, https://www.budget.gc.ca/fes-eea/2018/docs/statement-enonce/toc-tdm-en.html
xix. TimeLink™, https://nrc.canada.ca/en/certifications-evaluations-standards/canadas-official-time/network-time-protocol-ntp
xx. Evaluation of the Energy, Mining and Environment Program, https://nrc.canada.ca/en/corporate/planning-reporting/evaluation-nrcs-energy-mining-environment-research-centre
xxi. GC InfoBase, https://www.tbs-sct.gc.ca/ems-sgd/edb-bdd/index-eng.html#start
xxii. Evaluation of the Digital Technologies Program, https://nrc.canada.ca/en/corporate/planning-reporting/evaluation-nrcs-digital-technologies-research-centre
xxiii. Contaminated sites, https://www.canada.ca/en/services/environment/pollution-waste-management/contaminated-sites.html
xxiv. Public blockchain prototype, https://nrc-cnrc.explorecatena.com/en
xxv. Empowering Women in Chemistry event, https://iupac.org/event/empowering-women-in-chemistry-a-global-networking-event/
xxvi. Public Accounts of Canada, http://www.tpsgc-pwgsc.gc.ca/recgen/cpc-pac/index-eng.html
xxvii. National Research Council website, https://nrc.canada.ca/en/corporate/planning-reporting/financial-performance-reporting
xxviii. Ministers' mandate letters, https://pm.gc.ca/en/mandate-letters
xxix. Report on Federal Tax Expenditures, http://www.fin.gc.ca/purl/taxexp-eng.asp