



Evaluation of the All Domain Situational Awareness Program Defence Research and Development Canada



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ACRONYMS

ADM(DRDC)	Assistant Deputy Minister (Defence Research and Development Canada)	HR	Human Resources
ADM(Pol)	Assistant Deputy Minister (Policy)	ISR	Intelligence, surveillance and reconnaissance
ADM(RS)	Assistant Deputy Minister (Review Services)	L1	Level 1
ADSA	All Domain Situational Awareness	NATO	North Atlantic Treaty Organization
CAF	Canadian Armed Forces	NORAD	North American Aerospace Defence Command
CAUSE	Canadian Arctic Underwater Sentinel Experimentation	NWS	North Warning System
CFD	Chief of Force Development	OCI	Office of Collateral Interest
CFO	Chief Financial Officer	OGD	Other Government Department
CJOC	Canadian Joint Operations Command	OPI	Office of Primary Interest
CR	Core Responsibility	OTHR	Over-the-Horizon Radar
DGRDP	Director General Research and Development Programme	PQR	Program Quarterly Review
DGRDSE	Director General Research and Development Science and Engineering	RCAF	Royal Canadian Air Force
DGRDSP	Director General Research and Development Strategic Partnerships	R&D	Research and Development
DNA	Defence of North America	SAR	Synthetic aperture radar
DND	Department of National Defence	SJS	Strategic Joint Staff
DRDC	Defence Research and Development Canada	SRB	Senior Review Board
DRDCS	Director Research and Development Corporate Services	SSE	<i>Strong, Secure, Engaged</i>
DRDSRPM	Director Research and Development Strategic Resource Planning and Management	S&T	Science and Technology
DRDTIS	Director Research and Development Technical and Information Services	SWE	Salary and Wage Envelope
DSST	Defence and Security Science and Technology	TRG	Threat, Requirement and Gap
FTE	Full-time equivalent	TRL	Technology Readiness Level
FY	Fiscal Year	TCPED	Tasking, Collection, Processing, Exploitation and Dissemination
		US	United States
		UUV	Unmanned Underwater Vehicle

EXECUTIVE SUMMARY

This report presents the results of the evaluation of the All Domain Situational Awareness (ADSA) Science and Technology (S&T) program, conducted during Fiscal Year (FY) 2020/21 by Assistant Deputy Minister (Review Services) (ADM(RS)) in compliance with the Treasury Board [Policy on Results](#). The evaluation examines the relevance, effectiveness and efficiency of ADSA over its planned five-year period, FY 2015/16 to FY 2019/20.

ADSA Program Description

The chief objective of the ADSA research program is to generate knowledge to serve as a foundation for evidence-based advice regarding surveillance options of Canada's northern approaches. Defence Research and Development Canada (DRDC) is the primary delivery agent, and provides advice to Level 1 (L1) organizations to inform capability options and decision making. The program was A-base funded starting in FY 2015/16, and was extended to FY 2020/21.

Evaluation Scope

This report aligns with the Future Force Design (Science, Technology and Innovation) Program Inventory element for National Defence. The evaluation examined the ADSA program as the largest and most representative component of DRDC defence S&T research programming. Specifically, the assessment focused on the extent to which the ADSA program enables collaboration and generates knowledge, technologies and innovative options to address surveillance challenges, particularly in the Arctic.

Summary of Findings



Relevance

There is an ongoing and demonstrable need for ADSA scientific and technological knowledge and advice. The program is clearly aligned to governmental plans and priorities, and is directly informing policy development. ADSA research and development (R&D) provides relevant and innovative options for defence planning and future programs, and is informing the path forward in new large-scale research initiatives.

Effectiveness

The program made significant progress in generating options, knowledge and technology to inform defence planning and policy options. Innovative and promising research and solutions options have been achieved, particularly in system of systems. Moreover, strong partnerships are in place with research partners for joint achievements, particularly with North American Aerospace Defence Command (NORAD) and the United States (US) Department of Defense.

Opportunities for improvement include the need to have a sufficient planning/formulation phase prior to program launch, and having stronger integration of capacity and security requirements with partners. As well, there are gaps in the alignment of Department of National Defence (DND)/Canadian Armed Forces (CAF) operational priority setting and DRDC research planning.

Efficiency

The ADSA program spurred an innovative and successful integration of governance and shared outcomes. Its pan-domain approach led to better research, and is a significant achievement from the previous fragmented outcomes.

However, gaps remain that impeded progress and optimal efficiency of the program, including in the areas of: procurement management in support of research operations; people and communications management; and expenditure planning. In addition, there was a lack of strategic performance reporting to help inform corporate-level decisions in an orderly, consistent and performance-driven manner through the lifespan of the program.

The majority of gaps assessed by the evaluation were particularly present in the initial years of the program, and Assistant Deputy Minister (Defence Research and Development Canada) (ADM(DRDC)) has already made strides towards addressing them.

See [Annex A](#) for a complete list of findings and recommendations.

Overall Conclusions

The ADSA program demonstrates a successful initiative. It was an innovative approach to undertake significant research investments using a pan-domain governance structure with shared results. While mandated as an advisory and options-gathering initiative, ADSA is making significant contributions to defence planning and policy decisions and the way forward in ensuring remote surveillance capacity.

The lessons learned from ADSA, both in terms of achievements and opportunities for improvement, are already being used to develop the next generation of large-scale research undertakings, such as the Defence of North America (DNA) initiative.

EVALUATION SCOPE

Coverage and Responsibilities

This evaluation was conducted in accordance with the TB *Policy on Results* and the DND/CAF Five-Year Departmental Evaluation Plan (FY 2017/18 to FY 2021/22), approved annually by the Performance Management and Evaluation Committee.

The evaluation focused on examining a component of DRDC programs that is the largest and most representative of defence S&T research. As such, the assessment focused on the extent to which the ADSA program enables collaboration and generates knowledge, technologies and innovative options to address surveillance challenges in Canada, in particular those in the Arctic. The examination covers the program's planned lifespan of FYs 2015/16 to 2019/20, as well as the one-year extension of the program to FY 2020/21. The ADSA program will sunset in FY 2021/22. The outcomes from this evaluation, as well as a detailed lessons learned program report, will be used to inform the path forward for subsequent research programs – particularly the DNA initiative.

The objective of the evaluation is to assess the relevance, effectiveness and efficiency of the program.

The scope was developed in consultation with key stakeholders, including ADM(DRDC), Director General Research and Development Science and Engineering (DGRDSE), and Director General Research and Development Programme (DGRDP). Guidance was also received from ADM(DRDC) and ADM(RS).



Photo credit: Janice Lang,
DRDC/DND,
RDO-U-2020-0309-10072

Out of Scope

The following components were out of the scope for this evaluation:

- Research Centres (other than those related to ADSA)
- Mobilizing Innovation in Security and Defence
- Innovation for Defence Excellence and Security
- Canadian Safety and Security Program
- SCInergy 2020 and related strategic initiatives (although recent activities are identified towards building from ADSA outcomes)

The evaluation used multiple lines of evidence collected through qualitative and quantitative research methods (see [Annex C](#) for methodology and limitations).

Key Findings were developed and themed as per approved assessment indicators:

1 **Relevance**

2 **Effectiveness**

3 **Efficiency**

PROGRAM DESCRIPTION

[Video overview](#)

The Defence and Security Science and Technology (DSST) program aims to provide DND/CAF with an **advantage in knowledge, technologies and solutions for mission success while enabling a robust innovation base for Defence excellence and security.**

The DSST program (PI 4.8) supports the core responsibility (CR) to “*develop and design the future force through a deep understanding of the future operating environment and security risks to Canada and Canadian interests and to enhance Defence’s ability to identify, prevent, adapt and respond to a wide range of contingencies through collaborative innovation networks and advanced research*” (Departmental Results Framework, CR 4 Future Force Design).

In support of Canada’s defence policy: *Strong, Secure, Engaged* (SSE) priorities, the Deputy Head approved A-base funding for the ADSA S&T program, which launched in FY 2015/16 with funding for five years ending in FY 2019/20. A one-year extension was put in place for FY 2020/21 to allow for the closure of certain projects and for the consolidation of results validation.

The main objective of the ADSA program is to **generate knowledge to serve as a foundation for evidence-based advice regarding surveillance options of Canada’s northern approaches.** Most R&D is achieved by contracting out to industry and academia. A number of projects have received funding via the ADSA S&T Program including:

- Over-the-Horizon Radar (**OTHR**);
- Canadian Arctic Underwater Sentinel Experimentation (**CAUSE**);
- Threat, Requirement and Gap (**TRG**) Analysis;
- Compression of the Tasking, Collection, Processing, Exploitation and Dissemination (**TCPED**) Cycle.

See [Annex D](#) and [Annex E](#) for details on the main program components and subcomponents..

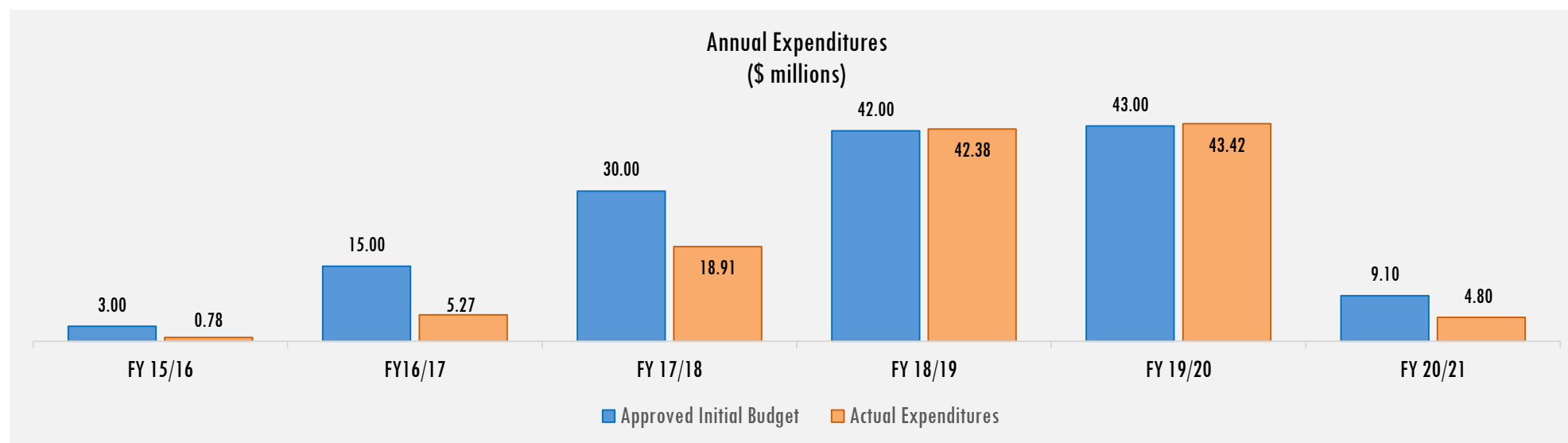


DRDC is the primary delivery agent for S&T R&D investments and needs. In addition to serving the needs of DND/CAF, DRDC also serves most L1 organizations including Army, Navy and Air Force, Strategic Decision Support, Joint Force Development, Operations and Personnel.

PROGRAM FUNDING PROFILE

In July 2015, in support of SSE priorities, the Deputy Head approved a five-year funding allocation of \$133 million, ending in FY 2019/20. ADM(DRDC) is the sponsor of the ADSA S&T program, on behalf of the Deputy Head and all L1s. An additional \$8.6 million was received through the ADM(DRDC) Business Plan for FY 2019/20, and a one-year extension was put in place for FY 2020/21 to allow for the closure of certain projects and for the consolidation of results validation (see [Annex F](#) for fiscal details).

	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21*	TOTAL
Approved Initial Budget (\$M)	3.00	15.00	30.00	42.00	43.00	9.10	142.10
Actual Expenditures (\$M)	0.78	5.27	18.91	42.38	43.42	4.80	115.57
Variance from Initial Budget (\$M)	2.22	9.73	11.09	-0.38	-0.42	4.3	26.53
Variance from Initial Budget (%)	73.9%	64.9%	37.0%	-0.9%	-1.0%	47.3%	18.7%
Full-time equivalent (FTE) allocations**	–	–	39.18	40.98	44.03	20.11	144.3



Source: ADSA Financial Reports (2019/2020; 2020/2021). *2020/21 actual expenditures are current as of January 28, 2021. ** FTE allocations only tracked from 2017/18 due to new database.

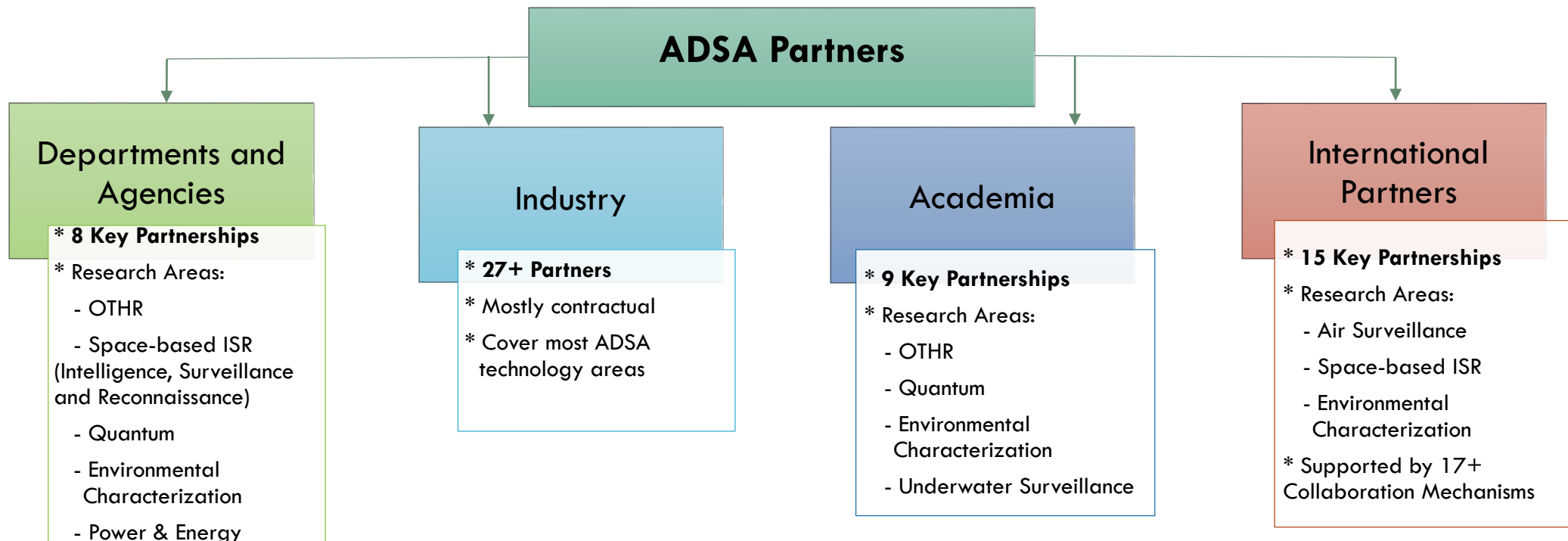
PROGRAM STAKEHOLDERS

DND/CAF: ADM(DRDC), Royal Canadian Air Force (RCAF) (including Director General Space), NORAD, Royal Canadian Navy, Canadian Joint Operations Command (CJOC), Strategic Joint Staff (SJS), Chief of Force Development (CFD) and Assistant Deputy Minister (Policy) (ADM(Pol)).

Other Government Departments (OGD): National Research Council, Canadian Space Agency, Canada Border Services Agency, Canadian Coast Guard, Royal Canadian Mounted Police, Natural Resources Canada, Fisheries and Oceans, Transport Canada and Environment Canada.

Allied & International Partnerships: Pentagon Assistant Secretary of Defense for Research and Engineering, US NORAD and Northern Command, US Space Command, North Atlantic Treaty Organization (NATO), Five Eyes Partners (US, United Kingdom, Australia and New Zealand), US Department of Defense Research Labs.

Private Industry & Academia: More than 27 industry partners and 9 key academic institutions are engaged in research and analysis to support the development of options for enhanced domain awareness of air, maritime surface and subsurface approaches to Canada and the Arctic in particular.



FINDING 1: The ADSA program aligns with the roles, responsibilities, and plans and priorities of the government and DND/CAF. The program also addresses strategic gaps identified by the government, and demonstrates an ongoing need for surveillance in the North and regional areas.

Alignment with government and departmental roles and responsibilities

The ADSA S&T program is a key element of SSE, which commits to better situational awareness through a number of initiatives, such as:

- Prioritizing Arctic joint intelligence, surveillance and reconnaissance as a defence R&D priority to produce innovative solutions to surveillance challenges in the North. (Initiative # 69)
- Collaborating with the US on development of new technologies to improve Arctic surveillance and control, including renewal of the North Warning System. (Initiative # 109)

In addition, the *National Defence Act* (Sect. 4) establishes the Minister as responsible for research relating to the defence of Canada.

Alignment with government and departmental plans, priorities and expected results

- Defence and Security S&T Strategy
- Canada first Defence Strategy and Canada's Defence Plan 2018-2023
- Speeches from the Throne and Mandate Letters (2015, 2019)
- Departmental Plans (Defence Innovation; Future Force Design)
- Departmental Results Reports (S&T)

Speeches from the Throne and Mandate Letters (2015, 2019) both indicate that the Government has mandated and legislated roles and responsibilities to focus on surveillance and control of Canadian territory and approaches, particularly the Arctic regions in order to defend Canadian sovereignty, protect North America and enhance international security.

ADSA is clearly aligned with the priorities of DND, and is denoted in the following Departmental Results:

- 4.1 – Defence capabilities are designed to meet future threats
- 4.2 – Defence and security challenges are addressed through innovative solutions.

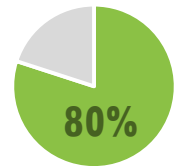
Ongoing need

Prior to ADSA, stewardship for northern and remote surveillance was scattered and fragmented between CAF elements; ADSA is a comprehensive research program operating across the domains (e.g., air, maritime surface, maritime subsurface) and developing synergies.

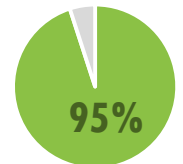
ADM(Pol) considers the ADSA program to be a key foundational element of NORAD modernization and continental defence work, The results and strategic advice provided by the program, have been critical to informing policy development and advice. For example, the ADSA program informs key departmental and governmental direction, including Budget 2021 and the current array continental defence policy.

Survey respondents agree and strongly agree that:

There were gaps (knowledge & technology) in defence S&T research **prior to the launch of ADSA.**



The overall **ADSA mandate aligns with the CAF's need** for strategic capabilities within north and remote aspects.



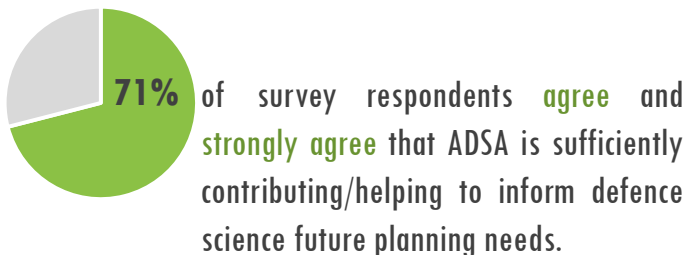
There is ongoing and demonstrable need for ADSA S&T knowledge and advice.



FINDING 2: ADSA is a key component of the government’s defence and security and technology science planning, and has significantly contributed to the development of relevant and strategic options for ensuring sovereignty over northern and remote areas.

The Government of Canada has prioritized Security and Technology science planning and has also placed emphasis on Arctic files and on government-based science supporting high-level outcomes. To respond to this additional responsibility, DND made an investment of \$133 million for the ADSA Program, from 2015 until 2020 to research and analyze, as well as identify, assess and validate technologies that can increase situational awareness in the air, on water and under water in the North.

ADSA has contributed to providing strategic advice to senior decision making within DND, the CAF, the US and NORAD.



ADSA S&T Program

Expanded the surveillance awareness in the Arctic in support of continental defence

Clearly demonstrates strategic and pan-domain solutions options; macro-level perspectives across domains (Army, Navy, Air Force)

Generates science-based evidence of the feasibility of surveillance technologies.

Has helped to inform planning, policy direction and strategic options in the field of defence S&T.

Creates options for CAF consideration and informs decisions on Force Development plans (e.g., multiple meetings at the senior review boards (SRB), presentations to the Minister’s Office, Chief of the Defence Staff).

Informs dialogue in DND and the Government on future acquisition projects for broader North American Defence capabilities and replacement of the North Warning System.

Through its R&D work and the four projects (OTHR, CAUSE, TCPED and TRG), ADSA is filling noted gaps and providing strategic capability and surveillance options for air, maritime surface and maritime subsurface.

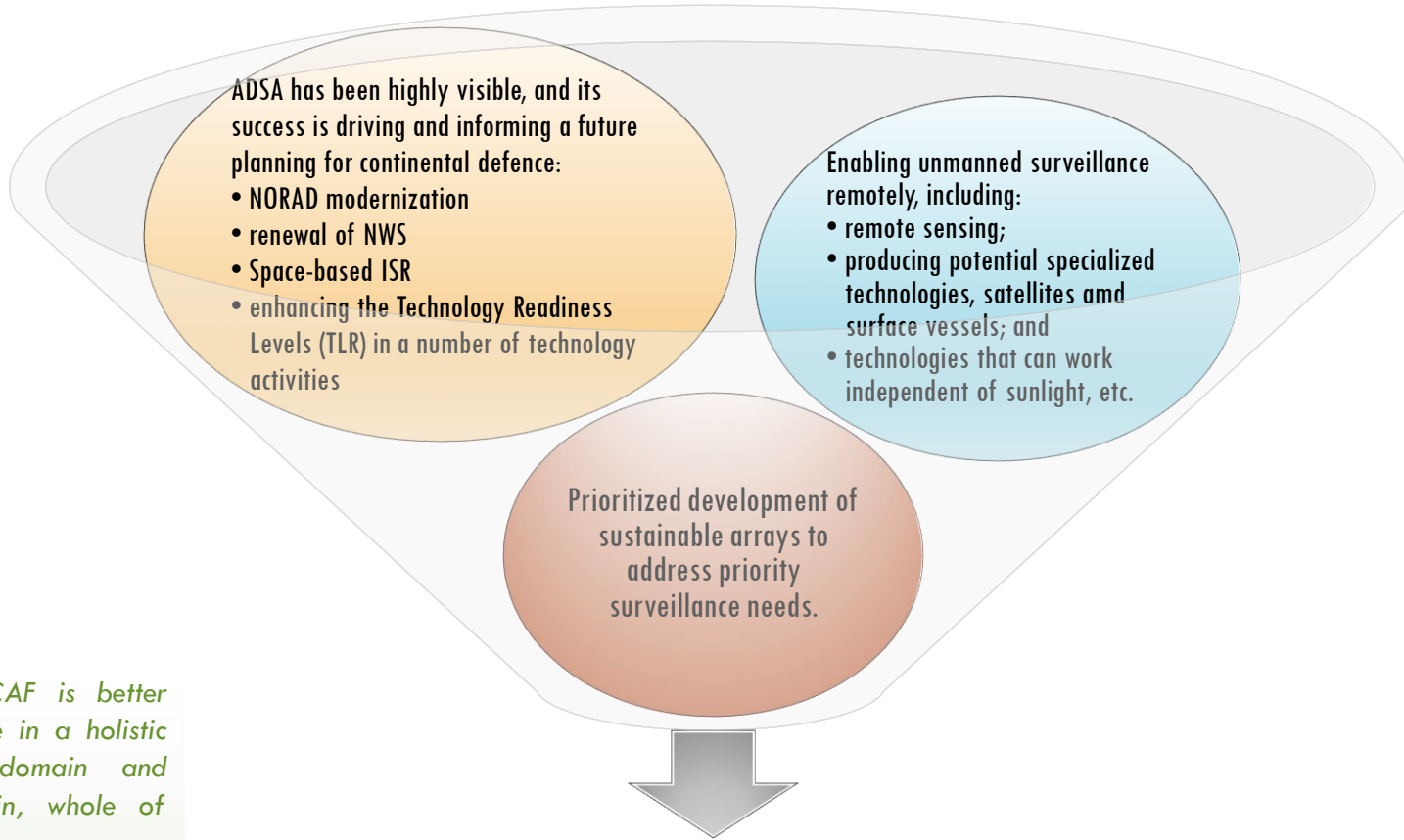
Program was envisioned to have a strategic contribution, which requires pan-domain research and solutions.

The ADSA S&T Program has extensively studied surveillance technology options for improved awareness of air, maritime surface and maritime subsurface activity approaching or in Canada’s north.

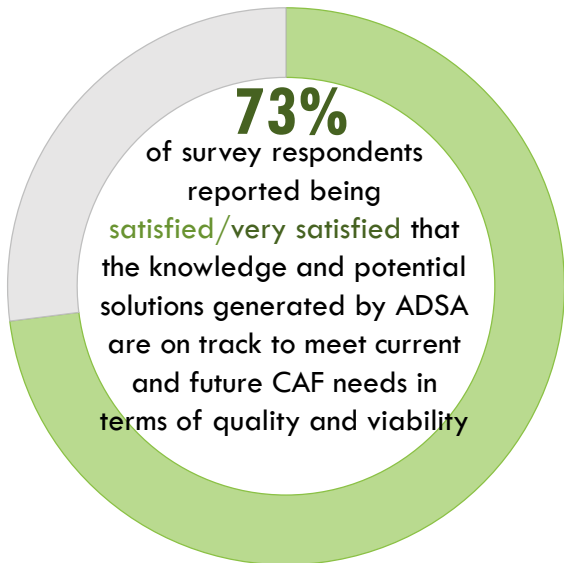
The ADSA S&T Program has informed, by evidence-based S&T advice, high-level decisions on future investments in surveillance solutions for enhanced domain awareness for the defence of Canada.

FINDING 3: ADSA effectively demonstrates the value-added for a pan-domain approach to research, and its outcomes are informing the way forward for future similar programs, such as the DNA initiative.

- The North Warning System (NWS) radar technology, which provides for current defence situational awareness in the Arctic, requires replacement as early as 2025.
- Advancements in threat capabilities, along with climate change and the evolution of strategic and global geopolitical factors, combine to create a new generation of threats, and require a modernization of NORAD’s surveillance capabilities.
- The changing nature of the threat context to North America requires that Canada and the US work together to improve their technology and upgrade their capabilities in order to defeat these threats.
- The results generated from the ADSA S&T program were carefully considered and used in the definition of a new program – DNA – which is considered a follow-up large-scale initiative.
- ADSA is also informing the array of NORAD and continental defence policy developed by ADM(Pol).



ADSA R&D provides relevant and innovative options for defence planning and future programs



“With ADSA in place, DND/CAF is better prepared to address surveillance in a holistic way, addressing issues pan-domain and developing strategic pan-domain, whole of coverage solutions.”
Interviewee

FINDING 4: A formal planning phase, including predictable annual funding and milestone setting, was not clearly defined prior to program launch, resulting in the delay of research and operational progress in the initial years.

Rapid and sudden funding

ADSA's funding allocation was rapid and sudden, which resulted in the initiation of projects without sufficient plans/charters and an accelerated execution of the program.

Lack of predictable funding resulted in insufficient planning/formulation phase

The Program was launched without a fulsome formulation phase, including the setting of priorities and milestones, and without sufficient gap analysis and business planning. Project business cases and proposals were developed quickly, the funding was approved and issued while ADSA had not yet fully articulated expected outcomes.

Document analysis and key interviews indicate that the lack of a formal planning/definition phase is one of the critical issues that limited the ability to effectively establish goals and outcomes, slowed progress in later years and delayed research and operational progress, thereby affecting ADSA's milestones, timeframes and schedules as well as clarity of goals and objectives. A one-year extension was put in place for FY 2020-21 to allow for the closure of certain projects and for the consolidation of results.

Some survey respondents commented that the lack of a clear formulation of research goals was an issue. Some interviewees noted while ADM(DRDC) officials helped inform departmental planning in northern surveillance planning, the ADSA-specific announcement seemed rushed.

Lack of predictable annual funding was also perceived as a barrier to a more effective program management cycle and long-term planning.

Challenges encountered in early years



Complexity of program (e.g., large stakeholder community; 'all domain' scope; size and remote nature of environment; range of expertise).



Initial unavailability of a Statement of Capability Deficiencies in the Maritime Domain.



Lack of project management office and project planning documentation; contracting delays; size and complexity of the first call for proposals; lack of a contracting mechanism to spend the money, absence of clear security clearances procedures and guides.



Expectations for innovative and collaborative approach to new research required additional time (e.g., solicitation of unique private sector bids; complying with contract ceilings, etc.), particularly for the CAUSE project.



R1 Ensure future large-scale research programs are based on a formal planning phase prior to launch, which includes setting objectives, defining milestones and establishing delegated authorities.

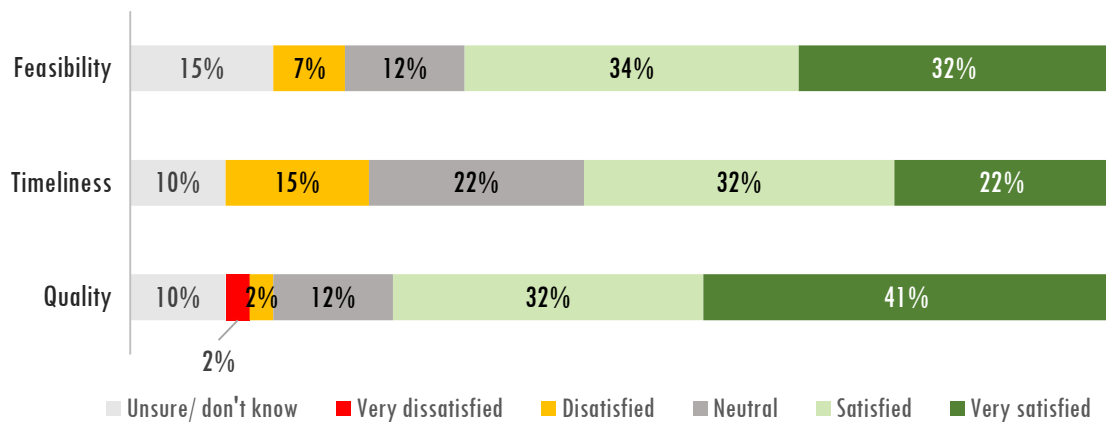


FINDING 5: The program made significant progress in generating options, knowledge and technology in the air domain, and to a moderate degree, in the maritime surface and subsurface domains.

Differing levels of progress across domains

- Advanced relatively more on the air side, in particular with NORAD.
- OTHR is the most promising, and it will be a key indicator for determining the degree to which ADSA has generated options that can be fully deployed.
- Logistics and security system differences between Canada and the US were sometimes an issue. Integration of research was somewhat more seamless with the US Air Force vs Navy.

Overall, survey respondents **are satisfied** that the knowledge and potential solutions generated by ADSA are on track to meet current and future CAF needs in terms of the **quality and feasibility of ADSA-related projects**, and are less satisfied with the timelines of projects.



Unique challenges of operating in northern and remote areas

Progress was made despite the fact that working in the Arctic has unique challenges.

1	Environment, geography and distances
2	Lack of the proper equipment to do required work (e.g., research vessels)
3	Logistics: cost of equipment, season-dependent schedules, contracting thresholds, setting up infrastructure
4	Sensitive nature of work/technology
5	Capacity challenges: exacerbated by the pandemic which slowed work or limited access to some sites

FINDING 6: Partnerships with international government agencies would benefit from further strengthening and nurturing, to fully share in scientific expertise and collaborative research.

Successful partnerships are in place but with certain challenges

ADSA's research and analysis was conducted in partnership with OGDs, Five Eyes allies, as well as engagements with academia and industry. Collaboration and partnership were key to ADSA. The US is Canada's primary ally as the two countries share common threats and there is a bi-national command in NORAD. The two countries share the Arctic and the responsibility of defending the North.

ADSA is to be achieved by "Leveraging Science Based Departments and Agencies, Canadian Industry, academia, and key international partnerships as core suppliers of knowledge, ideas, services and solutions."

ADM(DRDC) Initial Planning Guidance for ADSA, September 2015

Collaboration existed also with NATO allies and northern nations that had some similar areas of focus (see [Annex G](#) for international context). However, since the Program was specialized to northern approaches and involved highly classified projects and technologies, collaboration outside of Canada-US partnerships was limited.

Almost all interviewees and the majority of survey respondents agree that the ADSA program is fostering and effectively utilizing partnerships.

However, **68%** of survey respondents indicated that the ADSA program faces **internal** and **37%** **external** issues.



Photo credit: Janice Lang, DRDC/DND, RDO-2018-0319-07043

Challenges

- 1 Main collaboration is with US and NORAD; lack of security and classification integration
- 2 Limited relative funding constricts the contributions/participation of Canadian side
- 3 There are gaps in the integration of research with NORAD
- 4 Entering partnerships without full capacity in place, ramping up 'on the fly'

Approaches to classified information

There is a need to establish more effective and consistent approaches to classified information, which adversely affect the timeliness of projects and their integration with partners.

- Majority of interviewees and survey respondents noted that ineffective security and classification mechanisms and classification tools negatively affected partnerships and led to projects being delayed (e.g., differing security clearance systems in the US vs Canada).
- Terms and conditions of partnerships with US/NORAD would benefit from review or update to better coordinate research activities.
- Not prepared to deal with the differing security classification systems ahead of time, which caused delays.
- Lack of access to vehicles/research vessels for classified contracts interrupted the progress of some projects.
- Lack of dedicated facilities in DND/CAF for classified work.
- Some concern about security challenges in collaborations with the industry/academic realm.

Work underway

Program management recognizes the gap, and is currently developing security classification/clearances guides and support for major areas of research work.



Ensure internal processes and structures are in place to support effective scientific research work and international partnerships.

FINDING 7: There was a lack of clarity and prioritization from DND/CAF in its surveillance research and technological needs in the early stages of the program; there are opportunities for improvement to ensure DRDC research is strategic and risk based in addressing DND/CAF needs.

Gaps in the integration of DND/CAF operational planning and DRDC research planning

Canada's defence and security rely on DRDC and its partners to identify advances in S&T that give the CAF the edge they need for building capacity to overcome evolving unconventional or novel threats and to carry out their missions effectively. The ability of the CAF to defend and operate in the Arctic as well as other extreme or hostile environments is a priority.

To help DRDC deliver the needed S&T solutions to DND/CAF, as well as provide the advice needed to maintain a technological and knowledge advantage to protect and defend Canada's North, DND/CAF should have a proactive role to ensure clarity in their research and technology needs to DRDC.

DRDC

76% of survey respondents agreed that the ADSA projects are aligned with the wider priorities of the DSST program.

However, respondents and interviewees indicated that **there are inconsistent messages about DRDC priorities and how they should structure their work.**

- DRDC could engage more closely with the CAF.
- Workforce perceives a lack of clarity in how their work aligns with DRDC priorities and CAF operations.
- Work seems to be only on a project-by-project basis without prioritization.
- Awareness of DRDC priorities and strategic objectives not effectively in place.

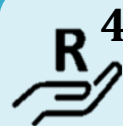
A concern from research staff is that **DRDC should** rely less on serving the needs of individual projects or Generals across different elements, and instead **use an integrated and prioritized approach.**

DND/CAF

The majority of survey respondents **agree/strongly agree** that **ADSA has helped to inform planning options** in the field of defence S&T (e.g., Force Development planning, CAF surveillance capacity in northern and remote areas).

However, **there is a lack of proactive direction** in terms of prioritization of solutions or technologies that should move forward:

- Priorities in the North are not clearly set/communicated.
- Resources and work remains on multiple research files that may not be a priority or reach fruition; lack of go/no go decisions.
- Lack of focussing resources on identified promising knowledge



4 Improve the clarity and prioritization of CAF scientific and technological research needs, and ensure DRDC research planning and decision making is based on a strategic and risk-based approach in alignment with DND/CAF needs.

FINDING 8. Innovative and promising research and solutions options have been achieved, particularly in system of systems and sensing technologies. However, as most of the ADSA outcomes are experimental and prototypical in nature, overall applicability against operational requirements has not yet been ascertained.

Significant amount of research is still at an experimental stage

The potential capabilities generated by knowledge, prototype equipment and other technical R&D options can only be demonstrated once they move from an experimental to a feasibility test state. Recognizing that ADSA is exploratory in nature, its investments are significant and have moved rapidly to get through the TRL and above. Some advice and solutions have been acted upon, and a significant amount of research is still at the cusp of demonstrating validity and field trials.

Virtually all interviewees expressed that ADSA's contributions toward developing innovative solution options for surveillance cannot be validated until moved to validation/feasibility level.

Challenges

Some of the challenges faced to reach the level of feasibility/operationalization include:

- Lack of exploitation plans and lack of clear decision making;
- Some projects feasibility/deployment level delayed due to COVID-19 (e.g., OTHR);
- Scope of the surveillance problem is larger than the resources attached to ADSA;
- While recognized as an options-gathering initiative, the five-year window of ADSA is not sufficient to determine operational solutions and elevating the TRL for most projects.



It is essential:
Applicability against operational requirements should be ascertained going forward.

Work underway

A detailed final report analyzing the range of technologies and concepts resulting from ADSA research is nearly complete, and is already informing surveillance planning and decision making going forward.

Operationalizing and adopting the knowledge and technology could be achieved through a follow-up program in which some of the projects can be pushed forward (e.g., new DNA research initiative).



Photo credit: Janice Lang,
 DRDC/DND,
 RDA-U-2020-0316-01254



Ensure that sound governance and pan-domain stewardship are in place to inform decision making on outcomes of ADSA options, and for upcoming large-scale research initiatives.

FINDING 9. There are opportunities for improvement within elements of contracting and procurement management, including:

- Lack of dedicated procurement expertise or project management office to provide guidance.
- Need for a more flexible and adaptive procurement process, rather than standard government-wide thresholds, to align with the unique nature of the research.
- Challenges with standard procurement requirements and processes to engage local workforce in the North, resulting in lack of access to valuable resources and opportunities to contribute to northern communities.

Gaps in support to research operations

Procurement management is essential to ensure contracting efficiency, fairness and transparency. Multiple factors contributed to perceived project delays and challenges, including **lack of dedicated procurement expertise and a project management office to support research work** and to provide guidance on intellectual property requirements. This was a particular challenge in the initial years of the program.

Processing time was often noted as an issue in both the document review and interviews.

- Of the estimated 492 contracts awarded to support ADSA, the evaluation found that the average processing time for contracts valued at \$25,000+ **is more than five months**.
- Also of note is the lack of performance data due to DRMIS integrity issue between 2016-2018.
- Recurring ADSA status reports indicate that delays in contracting impeded the achievement of High-level Deliverables and added risk to the schedule.
- For almost 80 percent of interviewees, contracting rules are viewed as overly complicated and lacking in clarity.

Contracting processes were also impacted by factors unique to ADSA, including:

- Sensitive and classified nature of some projects;
- Physical and remote environment in the Arctic, where work is restricted to summer months, and purchase approvals needed well in advance or season is lost; and
- Challenges in engaging local workforce due to perceived reporting burden from Ottawa Headquarters.

90% of interviewees and **19%** of survey comments indicated that **ADSA faced procurement challenges, creating delays**.

Work underway

ADM(DRDC) procurement has evolved since ADSA launched in 2015. The practice of identifying dedicated procurement support in the planning of major initiatives is in place. As well, DRDC has established a Community of Practice integrating procurement teams, and a functional authority team.

To better enable procurement and to support research partners, ADM(DRDC) has launched an electronic procurement ticketing application, and is developing a dedicated channel that will be regularly updated with new videos on a variety of procurement topics for training and information.



Photo credit: Steven Berry, DRDC/DND, RDA-U-20190819-00041



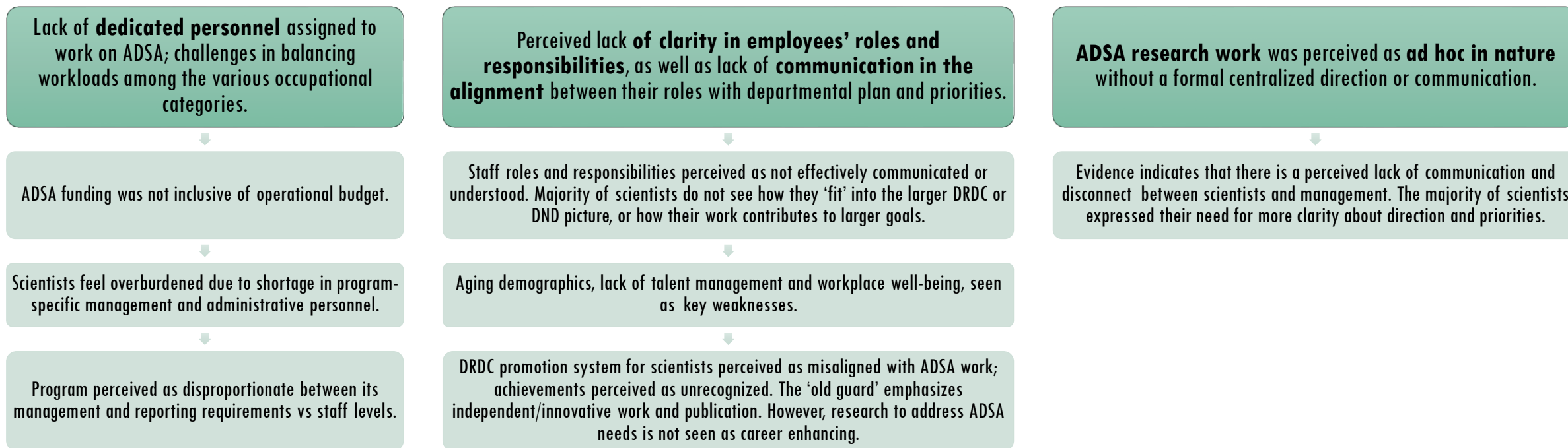
Address gaps in contracting and procurement management in support of research programming.

FINDING 10. There are opportunities for improvement in the management of communication and human resources (HR) in support of the program, including:

- a) Lack of clarity in staff roles and responsibilities, and in ensuring staff are aware of how their works fits within DRDC plans and priorities.
- b) Lack of regular internal communication, direction and outreach activities.
- c) Gaps in key elements of People Management, particularly with regard to talent management, recruitment/retention and employee support structures.

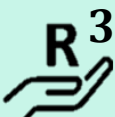
People Management

Certain key perceived gaps to a healthy workforce and workplace were identified throughout the evaluation’s survey, interviews, working groups and site visits. These include:



Unfunded support staff

The five-year \$133 million ADSA allocation was not commensurate with an increase in the Salary and Wage Envelope (SWE) for additional scientific or support staff, or a dedicated project management office. Moreover, a perceived lack of operational priorities resulted in existing staff undertaking ADSA research on top of their ongoing work.



R 3 Improve the overall management of internal communication and HR.



FINDING 11. While the overall five-year budget was set, annual cost forecasting and reallocations were not proactively planned or weighted against latter years ramp-up, leading to lapses.

Gaps in Business Planning

In the context of sudden funding, with annual allocation, flexibility and capacity to plan long term was limited. Evidence indicates that:

- there is a lack of proactive budget planning and risk analyses, especially in initial years;
- multi-fiscal years' nature of large complex projects not proactively considered;
- lack of flexibility to reallocate funding between years and long duration of large calls for proposals led to lapses.

Detailed business planning occurred after program launch in year one, with contracts and implementation of research not starting in earnest until year two or later. This also created delays and slippages of expenditures into forward fiscal years. Some reallocations were absorbed out of the baseline S&T budget to compensate at the end.

Inefficiencies in expenditure planning within the five years affected project timelines, and was a factor in the program seeking a one-year extension to the planned close-out of projects.

Furthermore, there is a lack of data on the FTEs and SWE linked to ADSA, and the funding did not include a dedicated allocation for the SWE.



Photo credit: Janice Lang, DRDC/DND, OTHR_Panorama1crop2

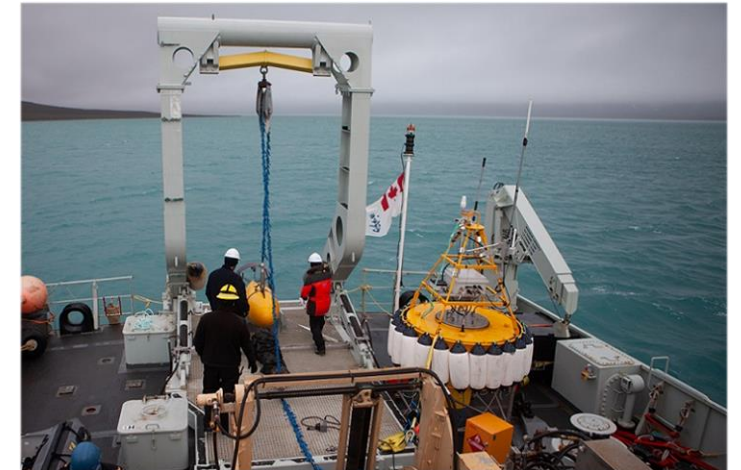


Photo credit: Steven Berry, DRDC/DND, RDA-U-20190827-00133

We could have done a better job at the onset, to give enough time for project definition and have proper plans and objectives set before implementation. ADSA just jumped into the projects without sufficient planning in year one.

ADSA funding envelope should have had a low start, a low end, and a peak in the middle. This could have helped in planning more effectively, more in a bell shape.

Interviewees



See
[Recommendation 1](#)

FINDING 12. It is not possible to fully ascertain the extent to which the program was delivered in a cost-efficient manner, as there are gaps in costing information, and the ratio of administrative to program costs could not be determined.

Lack of costing data and analysis

Assessment of cost efficiency of the program was not possible due to lack of data to determine the ratio of administrative to program costs.

The lack of administrative and overhead costing data is consistent with the perception from scientific staff that overwhelmingly indicated an undue reporting burden being placed on them. This feedback includes often cited challenges of subject matter expertise being requested for redundant administrative reports from multiple managers.

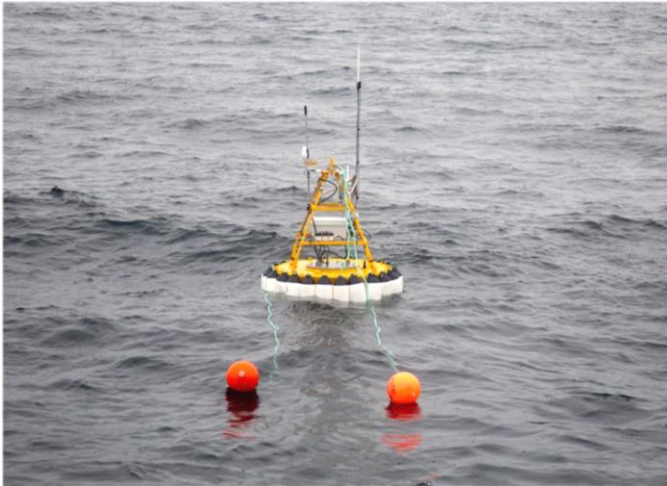


Photo credit: Steven Berry, DRDC/DND, RDA-U-20190827-00295

Insufficient tracking of administrative to program costs ratios

While most of the interviewed program stakeholders and some survey respondents indicated that program costs are generally constrained, they identified the need to better track the ratio of administrative to program costs.

Although overall spending information is available for project-based contracts and operations, detailed breakdowns of ADSA-specific scientific research Operation and Maintenance and administrative costs is not available.

Since ADSA is a sub-component of the larger S&T Program, its administrative costs were embedded as part of the baseline budget each year. Analysis of ADSA-specific costs and overhead was not formally tracked.

There is also an **absence** of FTE counts for the first two years and administrative overhead/program management costs for all years.

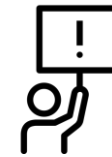
Scientists' time was consumed by administrative tasks; briefing reports, financial reports, preparing presentations. Scientists' unique skill set and knowledge, as well as their time, should mainly be used for advancing the science and not for administrative and program management.

Interviewee

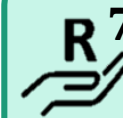
Overall efficiency

Notwithstanding gaps in data, indications are that overall spending against the budget was efficient and dedicated to projects-related deliverables.

The majority of stakeholders interviewed explained that, overall, most of the spending on the projects went to contracts, research, equipment and installation, and labour.



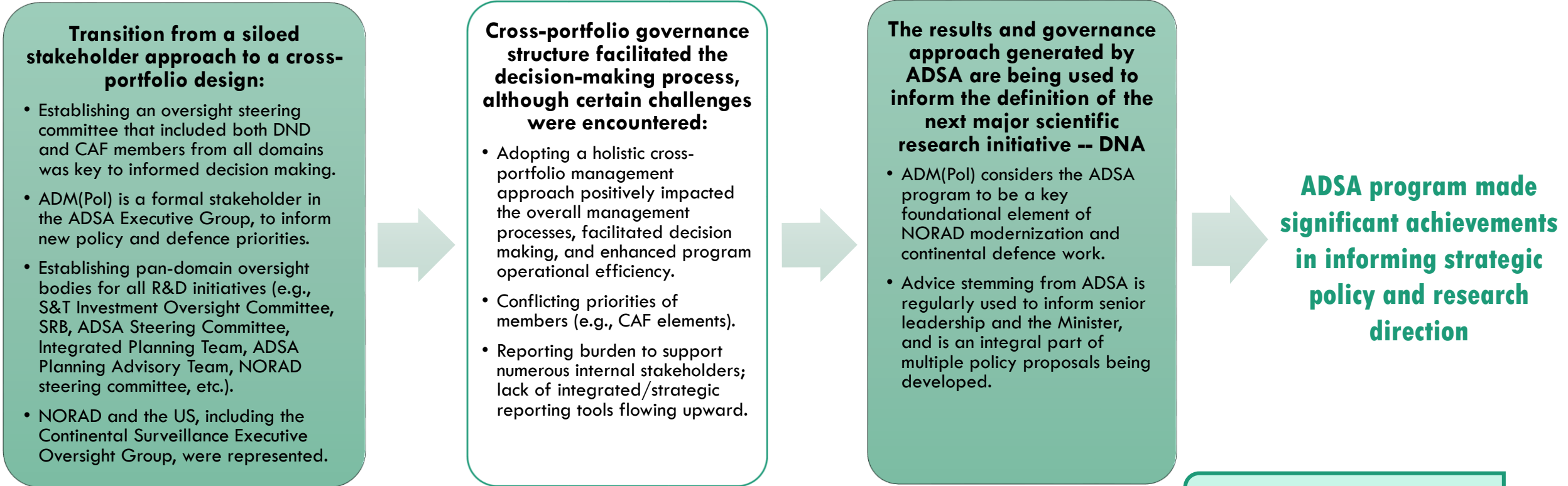
It is essential
Need to look for options to streamline the administrative burden in a future program.



Implement a strategy to ensure integrated performance-based decision making, inclusive of: maintaining program-level dashboards/reports; outcomes measured against plans and priorities; and cost efficiency.

FINDING 13. The ADSA program developed innovative and effective governance and oversight structures that are informing new large-scale research initiatives.

The ADSA program spurred an innovative and successful integration of governance and shared outcomes. Its pan-domain approach led to better research outcomes for the CAF across the elements. This represents a significant achievement and progress from the previous fragmented outcomes. ADSA was a key catalyst to move defence and security research away from a siloed stakeholder perspective to more holistic and integrated results for surveillance knowledge generation across the domains (e.g., air, maritime surface and maritime subsurface).



The **majority** of survey respondents and interviewees **agree** that the program has **effective governance and oversight structures**, with stakeholders/clients sufficiently represented.

R See [Recommendation 5](#)



FINDING 14. There are gaps in the use of performance-based metrics, and the program lacks the mechanisms to collect, analyze and integrate information from the various projects to inform strategic decision making.

While survey respondents and interviewees generally agree that ADSA’s decision-making process is informed by project results, an assessment of corporate-level performance measurement shows certain gaps:

<p>Lack of holistic strategic reporting on how ADSA is performing to help inform decisions in an orderly, consistent, performance-driven manner:</p> <ul style="list-style-type: none"> - Lack of robust and formal performance metrics in a consistent manner across projects; - Progress reports mainly on a project-by-project basis (e.g., project SRB); - No real-time update on changes to the scope of the projects at a program level; and - Lack of a robust strategic capability to analyze and integrate data from the various projects into a meaningful and tactical tool to inform decision making (e.g., strategic dashboard, recommendations, path forward, etc.). 	<p>Lack of external or neutral perspectives on performance to inform decision making.</p>	<p>Lack of scoping and milestone setting phase made validation of results against objectives difficult.</p>
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At the project level, progress is documented including data such as activities, budget, schedule, and scope and risk monitoring. Regular project Status Reports are used. This was enhanced with phased updates and Program Quarterly Reviews (PQR), or more frequently, as required. The results of the PQR from a financial, individual project status, critical timings, risk assessment and key milestones perspective were used to update the Program Status Report.

Progress was monitored on a project-by-project basis. Results were provided to senior management; the SRBs and the senior directors to monitor progress, understand the barriers, the constraints or the challenges. However, there was no external or neutral perspectives involved to monitor performance and provide informed scientific opinion to program management before proceeding to their decision making.

A holistic program-level approach in reporting could have been more effective in an integrated cross-portfolio program like ADSA S&T. The program lacks a holistic strategic reporting on its performance to help inform decisions in a consistent and performance-driven manner which affected providing real-time update on changes to the scope of the projects at the program level.

When the program was set up, it was not instrumented well, and it was not clear enough on what needed to be tracked in terms of performance metrics. So, performance measures and indicators which are fundamental to monitoring program progress and advancement to outcomes were not fully developed; work is needed to establish performance metrics in a consistent manner.

Additionally, the program did not have a robust strategic capability to analyze and integrate data from the various projects into meaningful and tactical tools and in a way that could be understood by all program stakeholders in order to inform decision making. These tools could include strategic dashboards, which would help in monitoring and analyzing the status of key performance indicators and help in setting the recommendations and direction.

The rapid launch of ADSA impacted the ability for an effective planning phase for the Program, including fully defining scope and setting milestones. This made validation of results against objectives difficult. Program stakeholders explained that since they find themselves at the back end of ADSA funding without knowing what comes next means that the program might not have had clarity on the setting of goals and outcomes, and measuring progress/achievements against them.

 See [Recommendation 7](#)

CONCLUSIONS

There is a demonstrable need for the ADSA program and its scientific and technological knowledge and advice. The program is clearly aligned to governmental plans and priorities, and is directly informing policy. ADSA R&D provides relevant and innovative options for defence planning and future programs, and is also informing the path forward in new large-scale research initiatives. To support these programs in achieving expected results in an effective and efficient manner, this evaluation has made recommendations in the following areas:

Future large-scale research programs and initiatives should have formal and sufficient planning prior to launch. ADSA expected outcomes were not clearly established in advance of operations, and results were adversely impacted by the lack of objective setting, defining milestones and establishing delegated authorities. Consequently, there was a delay of progress in the initial years.

Future similar initiatives to build off the successes of the ADSA program in the utilization of a pan-domain approach to governance and objective setting. The ADSA program was a key catalyst to move defence and security research away from a siloed stakeholder perspective to more holistic and integrated results for surveillance knowledge generation (e.g., air, maritime surface and maritime subsurface).

There is a need to improve the clarity and alignment between DND/CAF research priorities and DRDC strategic planning. The next generation of large-scale pan-domain research programs would benefit by DND/CAF clearly setting its surveillance research and technological needs, and by DRDC having planning that is strategic, relevant and risk based rather than on a per-project basis.



Continued efforts to improve the overall management of internal communication and HR in relation to the scientific community is encouraged. Key elements of People Management, especially talent management, recruitment/retention and employee support structures should be in place. Staff should be aware of how their work fits within DRDC plans and priorities. Ongoing and regular communication, direction and outreach activities need to be in place.

Efforts underway to address gaps in contracting and procurement management in support of research programming should continue. These efforts, such as strengthening internal project management expertise, guidance and administrative capacity in support of scientific work, help ensure the efficiency of programming.



Internal processes and structures should be in place to support effective scientific research work and international partnerships. While the ADSA program demonstrated the importance of international collaboration to attaining greater results, upcoming research initiatives should ensure mechanisms are in place for an efficient system to identify, retain and share classified information.

Future programming should have strategic performance-based decision making in place, and include ongoing tracking and outcomes measured against plans' cost efficiency. The ADSA program was impacted by gaps in the use of performance-based metrics, and lacked the mechanisms to collect, analyze and integrate information from the various projects to inform strategic decision making.



ANNEX A – KEY FINDINGS AND RECOMMENDATIONS

 KEY FINDING	 RECOMMENDATION
RELEVANCE	
<p>1. The ADSA program aligns with the roles, responsibilities, and plans and priorities of the government and DND/CAF. The program also addresses strategic gaps identified by the government, and demonstrates an ongoing need for surveillance in the North and regional areas.</p>	
<p>2. ADSA is a key component of the government’s defence and security and technology science planning, and has significantly contributed to the development of relevant and strategic options for ensuring sovereignty over northern and remote areas.</p>	
<p>3. ADSA effectively demonstrates the value-added for a pan-domain approach to research, and its outcomes are informing the way forward for future similar programs, such as the DNA initiative.</p>	

ANNEX A – KEY FINDINGS AND RECOMMENDATIONS (continued)

 KEY FINDING	 RECOMMENDATION
EFFECTIVENESS	
<p>4. A formal planning phase, including predictable annual funding and milestone setting, was not clearly defined prior to program launch, resulting in the delay of research and operational progress in the initial years.</p>	<p>1. Ensure future large-scale research programs are based on a formal planning phase prior to launch, which includes setting objectives, defining milestones and establishing delegated authorities.</p>
<p>5. The program made significant progress in generating options, knowledge and technology in the air domain, and to a moderate degree, in the maritime surface and subsurface domains.</p>	
<p>6. Partnerships with international government agencies would benefit from further strengthening and nurturing, to fully share in scientific expertise and collaborative research.</p>	<p>2. Ensure internal processes and structures are in place to support effective scientific research work and international partnerships.</p>
<p>7. There was a lack of clarity and prioritization from DND/CAF in its surveillance research and technological needs in the early stages of the program; there are opportunities for improvement to ensure DRDC research is strategic and risk based in addressing DND/CAF needs.</p>	<p>4. Improve the clarity and prioritization of CAF scientific and technological research needs, and ensure DRDC research planning and decision making is based on a strategic and risk-based approach in alignment with DND/CAF needs.</p>
<p>8. Innovative and promising research and solutions options have been achieved, particularly in system of systems and sensing technologies. However, as most of the ADSA outcomes are experimental and prototypical in nature, overall applicability against operational requirements has not yet been ascertained.</p>	<p>5. Ensure that sound governance and pan-domain stewardship are in place to inform decision making on outcomes of ADSA options, and for upcoming large-scale research initiatives.</p>

ANNEX A – KEY FINDINGS AND RECOMMENDATIONS (continued)

 KEY FINDING	 RECOMMENDATION
EFFICIENCY	
<p>9. There are opportunities for improvement within elements of contracting and procurement management, including:</p> <ul style="list-style-type: none"> a) Lack of dedicated procurement expertise or project management office to provide guidance. b) Need for a more flexible and adaptive procurement process, rather than standard government-wide thresholds, to align with the unique nature of the research. c) Challenges with standard procurement requirements and processes to engage local workforce in the North, resulting in lack of access to valuable resources and opportunities to contribute to northern communities. 	<p>6. Address gaps in contracting and procurement management in support of research programming.</p>
<p>10. There are opportunities for improvement in the management of communication and HR in support of the program, including:</p> <ul style="list-style-type: none"> a) Lack of clarity in staff roles and responsibilities, and in ensuring staff are aware of how their works fits within DRDC plans and priorities. b) Lack of regular internal communication, direction and outreach activities. c) Gaps in key elements of People Management, particularly with regard to talent management, recruitment/retention and employee support structures. 	<p>3. Improve the overall management of internal communication and HR.</p>
<p>11. While the overall five-year budget was set, annual cost forecasting and reallocations were not proactively planned or weighted against latter years ramp-up, leading to lapses.</p>	<p>See recommendation 1.</p>
<p>12. It is not possible to fully ascertain the extent to which the program was delivered in a cost-efficient manner, as there are gaps in costing information, and the ratio of administrative to program costs could not be determined.</p>	<p>7. Implement a strategy to ensure integrated performance-based decision making, inclusive of: maintaining program-level dashboards/reports; outcomes measured against plans and priorities; and cost efficiency.</p>
<p>13. The ADSA program developed innovative and effective governance and oversight structures that are informing new large-scale research initiatives.</p>	<p>See recommendation 5.</p>
<p>14. There are gaps in the use of performance-based metrics, and the program lacks the mechanisms to collect, analyze and integrate information from the various projects to inform strategic decision making.</p>	<p>See recommendation 7.</p>

ANNEX B – MANAGEMENT ACTION PLAN

ADM(DRDC) has proactively utilized lessons learned from the ADSA program to inform current and future programs, particularly the DNA program. Furthermore, ADM(DRDC) will engage DND Chief Financial Officer (CFO) to establish more predictable funding levels for the DSST Program so as to better serve Partners' requirements.

In addition, ADM(DRDC) launched SCInergy 2020 in fall 2018, a coordinated strategic effort to identify gaps and define recommendations to improve the overall management of the organization. All activities undertaken were linked to four pillars: Governance; People; Process; and Impact. Several SCInergy recommendations are in process or have been implemented that directly or indirectly respond to recommendations in the ADSA evaluation, including creating clear responsibilities and authorities for Program Management. ADM(DRDC) is committed to continuous improvement on all aspects of its program including finding ways to be more agile with procurement processes to increase the overall impact of science for the department.

In the years since ADSA was launched, ADM(DRDC) has revised its organizational structure to break down silos and create an internal synergy between the various program stakeholders. As such, ADM(DRDC) is now managing one integrated DSST Program. A new reinforced governance with the Science and Technology Investment Steering Committee, the DSST is aligned with CAF priorities.

ADM(RS) Recommendation



1. Ensure future large-scale research programs are based on a formal planning phase prior to launch, which includes setting objectives, defining milestones and establishing delegated authorities.

Management Action

- ADM(DRDC) has established the directorate of DGRDP to centrally plan and coordinate all DSST program activities, including setting program objectives, defining program milestones and establishing delegated authorities.

OPI: Chief Of Staff (DRDC)

Target Date: COMPLETE

- As unexpected influxes of ADSA funds caused significant challenges and prevented adequate planning processes, to prevent this from occurring again, the CFO will be engaged to re-evaluate ADM(DRDC) baseline funding requirements.

OPI: Chief of Staff (DRDC)

Target Date: March 2023 (a one-page status update will be provided by March 2022)

OPI: Assistant Deputy Minister (Finance)

ADM(RS) Recommendation



2. Ensure internal processes and structures are in place to support effective scientific research work and international partnerships.

Management Action

- ADM(DRDC) will continue to strengthen strategic partnerships with the US, NORAD and other stakeholders through analysis of current agreements and tools; complete a decision tool for prioritizing strategic partnerships; provide key recommendations to ADM(DRDC) for future partnerships and associated processes.

OPI: DGRDSP




Target Date: June 2023 (a one-page status update will be provided by March 2022)

- ADM(DRDC) will complete options analysis and subsequently present the proposal for the Science & Technology Enhanced Research Capability (a Secret and Top Secret Research network enabling the sharing of research and information with partners and allies) to DND's Project Management Board for Project Approval (Definition) and subsequent transfer of project responsibility to Assistant Deputy Minister (Information Management).

OPI: DRDTIS

Target Date: April 2022

ANNEX B – MANAGEMENT ACTION PLAN (continued)

ADM(RS) Recommendation		Management Action
3. Improve the overall management of internal communication and HR.		<ul style="list-style-type: none"> Building upon an independent study, action has been completed on increasing dedicated corporate communications resources and implementing improved internal communications processes, ADM(DRDC) will continue to enhance its internal communications capabilities. OPI: DRDSRPM Target Date: COMPLETE ADM(DRDC) will develop a strategic HR plan to deal with challenges and opportunities related to talent management, succession management and recruitment. OPI: DRDSRPM Target Date: March 2022 ADM(DRDC) will continue to strengthen its application of the established R&D Capability Health Assessment process to assess its capacity to deliver current R&D capabilities and anticipate future capability needs. This broader assessment will enable DRDC to identify capability areas targeted for growth, sustainment and/or divestment. This process will address workload challenges, reallocate resources to priorities and fill the identified gaps. OPI: DGRDSE Target Date: March 2023 (a one-page status update will be provided by March 2022)
ADM(RS) Recommendation		Management Action
4. Improve the clarity and prioritization of CAF scientific and technological research needs, and ensure DRDC research planning and decision making is based on a strategic and risk-based approach in alignment with DND/CAF needs.		<ul style="list-style-type: none"> The establishment of the Science and Technology Investment Steering Committee in December 2020, and the process by which L1 R&D requirements are assessed and prioritized against DND priorities has been completed. OPI: DGRDP Target Date: COMPLETE The establishment of the collection, management and prioritization process of L1 partner requirements has been completed. OPI: DGRDP Target Date: COMPLETE
ADM(RS) Recommendation		Management Action
5. Ensure that sound governance and pan-domain stewardship are in place to inform decision making on outcomes of ADSA options, and for upcoming large-scale research initiatives.		<ul style="list-style-type: none"> ADM(DRDC) has implemented new DSST program governance structure in December 2020 to steer R&D investment, assess and prioritize R&D activities and deliver large-scale research programs. OPI: ADM(DRDC) Target Date: COMPLETE

ANNEX B – MANAGEMENT ACTION PLAN (continued)

ADM(RS) Recommendation



6. Address gaps in contracting and procurement management in support of research programming.

Management Action

- DRDC procurement processes have been improved and/or implemented to directly support major DSST programs or initiatives. The DRDC Procurement team has implemented a fully harmonized procurement process that is in accordance with all departmental and Treasury Board Secretariat policies and directives, and implemented an electronic procurement ticketing application to improve accuracy and efficiency of the procurement request process. DRDC has also established a strong Community of Practice amongst the regional procurement offices and the senior procurement leadership within DRDC.

OPI: DRDCS

Target Date: COMPLETE

- In the designing of future major research initiatives, DRDC has established the practice of incorporating procurement and project management staff as part of the planning process.

OPI: DRDCS

Target Date: COMPLETE

ADM(RS) Recommendation



7. Implement a strategy to ensure integrated performance-based decision making, inclusive of: maintaining program-level dashboards/reports; outcomes measured against plans and priorities; and cost efficiency.

Management Action

- ADM(DRDC) will establish and enhance strategic level performance dashboards that cover all program activities to inform decision making at various DRDC committees, including the Science and Technology Program Advisory Committee.

OPI: DGRDP

Target Date: December 2021

- DRDC will expand its performance management framework to incorporate high-level performance requirements for the DSST program.

OPI: DRDSRPM

Target Date: March 2023 (a one-page status update will be provided by March 2022)

ANNEX C – EVALUATION METHODOLOGY AND LIMITATIONS

The evaluation findings and recommendations were informed by multiple lines of evidence and qualitative and quantitative research methods collected throughout the conduct phase to strengthen rigour and ensure the reliability of information and data supporting findings. These lines of evidence were triangulated and draft findings shared with program management as part of a collaborative process to ensure accuracy and impartiality. The research methodology used in the scoping and conduct of the evaluations are as follows:

Document and literature review, administrative and financial data review

A preliminary review of the foundational documents was conducted during the planning phase which supported developing a comprehensive understanding of the program and informed the development of the scope and the evaluation matrix. The review was expanded extensively during the conduct phase of the evaluation, and the program provided a database of planning, performance measurement, financial and HR, and other documents that were requested for data gathering and analyses. The evaluation team reviewed over 200 documents, including; departmental administrative reports; program documents; program status reports; minutes of meetings; departmental plans; results reports; policies and mandates applicable to the program; and internal and external websites.

Key informant interviews

The evaluation team worked with a program liaison to identify interviewees. There was a total of 36 interviews conducted with a range of stakeholders including ADM, DG, DSTCE, DRDC DCs, TCPED, CAUSE, OTHR, DND/CAF partners: NORAD, RCAF. A number of program stakeholders had confidential discussions with the evaluation team. Interview data was thoroughly captured which allowed a robust thematic analysis to be performed. The data was cross-referenced against other lines of evidence.



Survey

A bilingual web-based survey was developed and administered to a wide range of stakeholder respondents internally and externally. The survey focussed on assessing the effectiveness and efficiency of the program. The survey was developed using Snap Survey Software and conducted using the internal (Defence Wide Area Network) and external Snap WebHost platforms. The web survey link was distributed by email to personnel/stakeholders with a variety of levels and of past or current involvement in the program: CAF members, finance/project management, scientists, procurement, etc. The online survey was live for two weeks (from December 4 – December 18, 2020). During this timeframe one reminder email was sent. Overall, there was a strong response rate of ~ 48 percent (41/86).



Case studies and site visits

In order to capture fulsome and operational information pertaining to programs, the evaluation teams typically conduct site visits. The evaluation team employed a case study approach which included conducting a site visit to gain additional insight into some of the projects' S&T activities and work in progress. The evaluation team undertook a tour of the antenna arrays models at Ottawa Research Centre near Shirley's Bay. The tour covered the Transmit Area 2 and the Receive Area 6. Although originally it was intended to cover all four regions where DRDC research centres are located: Alberta, Ontario, Quebec and Atlantic, the pandemic and associated travel restrictions prevented the evaluation team from conducting the fulsome case study portion of the assessment methodology.



Focus group interviews

Due to the pandemic, the evaluation team conducted only one focus group session to capture direct in-person information from DRDC scientists from Ottawa Research Center. The focus group was also followed up with confidential discussions that were requested by either some of the focus group participants or other stakeholders who were referred to the evaluation management by their colleagues to share their perspectives on some aspects of the evaluation.

ANNEX C – EVALUATION METHODOLOGY AND LIMITATIONS (continued)

Evaluation Limitations

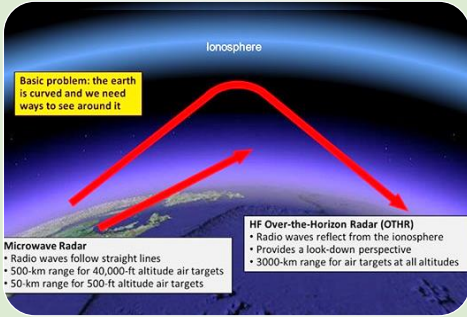
The limitations encountered by the evaluation and mitigation strategies employed in the evaluation process are outlined below.

Limitations	Mitigation Strategies
<p>Pandemic impact: Due to the global pandemic and restrictions on travel, the evaluation was limited to one local visit within Ottawa.</p>	<p>The evaluation team used multiple lines of evidence and conducted a larger than normal number of interviews. Additionally, a broad and in-depth review and analysis of program documents was performed.</p>
<p>Performance measurement data on FTEs, procurement and contracting: Due to integrity issues in DRMIS that were encountered by the program in the initial years, FTE data and performance information on procurement and contracting is limited.</p>	<p>This limitation was addressed by using trends from the later years of the program, and triangulating evidence from multiple sources and lines of evidence to inform the findings (e.g., survey, program document review with a focus on status reports, and interviews from stakeholders at varying levels).</p>
<p>Interview bias: Interviews might have included subjective impressions and comments which could lead to biased perceptions.</p>	<p>Interviewees were invited from a broad range of specialities and responsibilities, and data was supplemented from other lines of evidence. The evaluation team relied also on in depth analysis of program documents, survey results and focus group interviews.</p>

ANNEX D – PROGRAM COMPONENTS – Overview

[Video overview](#)

The ADSA initiative applies S&T research to identify, develop and demonstrate potential solutions for enhanced surveillance and detection capabilities across space, air and maritime domains for the CAF, particularly in the North. Projects in support of the ADSA program include:



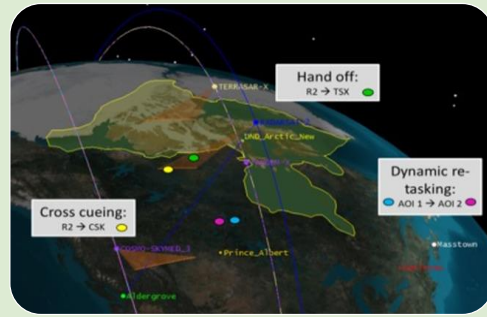
Air Integrated Polar Over-The-Horizon Radar (OTHR)

Longer range radar in the Arctic

Project objectives:

- To assess the viability of OTHR as an option for the surveillance of the North in augmentation to current NWS and NORAD capability.
- To develop technology and signal processing techniques to characterize the phenomenology of the impairments introduced by Aurora Borealis.

Deliverables: Capabilities, tools, knowledge, concepts and advice.



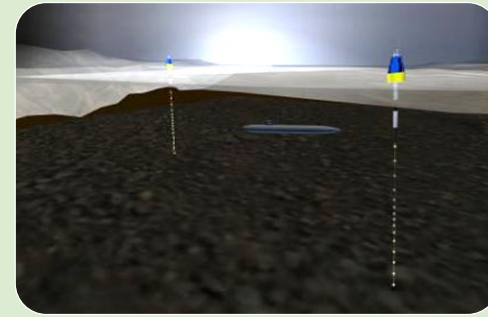
Compress the Tasking, Collection, Processing, Exploitation and Dissemination (TCPED) cycle

Facilitates decision-making cycle

Project objectives:

- To compress the TCPED intelligence cycle for RADARSAT Constellation Mission follow-on missions, so as to:
 - * Increase utility for Maritime Domain Awareness, Arctic Surveillance and other geospatial intelligence
 - * Permit cueing of other satellites
 - * Increase data uptake/reliance by Allies
 - * Strengthen Canada's niche role in Space-Based Radar
 - * Wide area maritime surveillance and dark-target detection

Delivered through Defence Innovation Research Program calls to Industry/Academia (50% funded by bidder).



Canadian Arctic Underwater Sentinel Experimentation (CAUSE)

Improves underwater surveillance

Project objectives:

- Investigate and demonstrate sensor systems for wide-area underwater and under-ice surveillance in the Arctic (includes Arctic Basin and Canadian Archipelago).
- Look at various sensor/enabler technologies for large area long range underwater surveillance such as acoustic arrays, vertical and Unmanned Underwater Vehicle (UUV) towable array, acoustic sound source for surveillance and underwater communications, and a long range UUV.

Deliverables: Technology demonstrations and advice on underwater/under-ice surveillance technologies and methodologies.



Threat, Requirements and Gap (TRG) Analysis

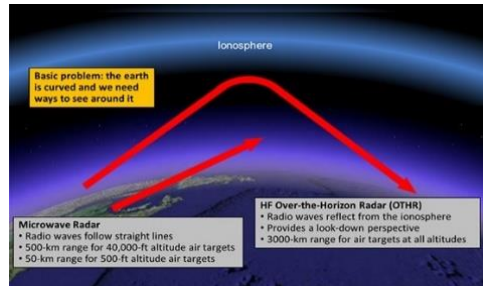
Understanding security challenges in Canada, in particular the Arctic

Project objectives:

- Assess all domain threats in the Canadian Arctic and relevant approaches;
- Analyze surveillance requirements in support of CIOC and NORAD;
- Compare selected technology options against these requirements;
- Analyze Arctic/ISR capability gaps in support of CFD, Canadian Forces Intelligence Command, SJS and ADM(Pol).

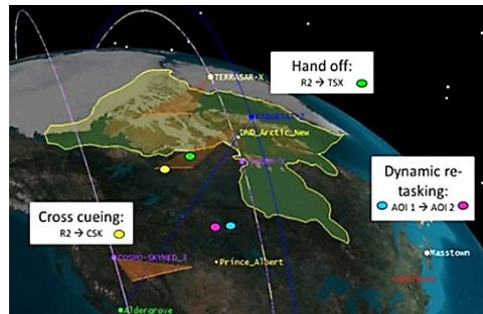
Deliverables: Knowledge, concepts and advice on air, maritime surface and subsurface threats, surveillance requirements and gaps.

ANNEX D – PROGRAM COMPONENTS (continued)



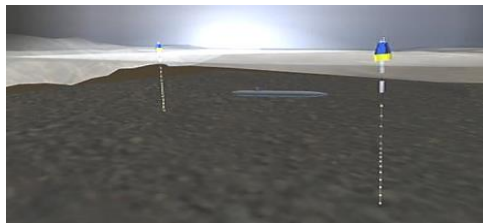
The purpose of **OTH** systems is to detect out-of-sight targets far beyond the horizon, unlike traditional radar which is limited to much closer line-of-sight objects. The bouncing of radar waves off the upper atmosphere allows OTHR to achieve a much longer range for target detection.

OTH systems are currently operational worldwide; however, in the northern regions signals passing through and reflected from the Aurora Borealis can diminish their performance. This project was launched to study possible ways to improve the performance when the Aurora Borealis is present.



In 2016, an initiative was launched, through a series of contracts, to improve the **TCPED cycle** for future Canadian earth observation satellites. The contracts are modeled on the Defence Innovation Research Program structure and are funded 50/50 between government and industry.

These cutting-edge projects offer innovative ideas on how to best maintain, enhance and modernize the CAF's capabilities to observe the earth using satellites. They will ensure an accurate, timely and uninterrupted picture of Canada's territory, including its air and maritime regions. They will also contribute to joint efforts between Canada and the US to improve surveillance capabilities in support of Canadian and NORAD requirements and missions.



The **CAUSE** Project develops and tests various surveillance systems for underwater and under-ice surveillance throughout the Arctic. The project enhances the CAF's capabilities and readiness to conduct operations in a changing Arctic environment.



The **TRG Analysis** Project assesses threats to three physical domains in Canada's North: air, maritime surface and maritime subsurface. The project then analyzes the gaps in Arctic intelligence, surveillance and reconnaissance capabilities and develops technology options and concepts that will assist the CAF in better operating in the changing Arctic environment. It also examines surveillance requirements and compares possible technological solutions.

ANNEX E – PROGRAM SUBCOMPONENTS

The following contracts were awarded for the ADSA projects:

Project Title	Subproject Title	Supplier
OTHR	Development of the Canadian High Arctic Ionospheric Models	University of New Brunswick
	Polar Over-the-Horizon Radar – Transmit Site	Raytheon Canada Ltd
	Polar Over-the-Horizon Radar – Receive Site, Raytheon Canada Ltd	Raytheon Canada Ltd
TCPED: First Round of Project Submissions (11 subprojects)	Real time TCPED cycle for RADARSAT Constellation Mission Follow-On	Airbus
	Multi-aperture synthetic aperture radar (SAR) tools	C-CORE
	Electromagnetic monitoring and analysis 2.0	Com Dev
	Constellation mission planning system	Globvision
	Tactical on-board processing innovation	MDA
	A system of systems approach to improving TCPED	MDA
	Sensor tasking and data collection management using high-level information fusion for improved system of systems operation	Larus
	Fusion of open data sources with automated identification system and Earth observation data for enhanced marine domain awareness	OODA
	Multi aperture multi-frequency digital SAR	UrtheCast Corp.
	Real-time on board automated tasking	UrtheCast Corp.
	On-board processing of SAR data	UrtheCast Corp.

ANNEX E – PROGRAM SUBCOMPONENTS (continued)

Project Title	Subproject Title	Supplier
TCPED: Second Round of Project Submissions (12 subprojects)	Complementary Electro-Optic/Infrared payload to RADARSAT Constellation Mission	ABB
	Project Arviq	AstroCom Associates Inc.
	Multi-satellite data integration for operational ship detection, identification and tracking	C-CORE
	Modelling the geospatial intelligence capability to support Canadian surveillance and sovereignty	C-CORE
	Electro-Optic/Infrared data analytics for enhanced maritime surveillance	Complex System Inc.
	RADARSAT thematic exploitation platform demonstrator	CubeWerx Inc.
	Real-time processing of large-volume space-based multimodal data	General Dynamics Mission Systems
	Augmenting Canada's maritime surveillance capability with complementary electro-optic/infrared information products	MDA Systems Ltd
	Persistent multi-sensor land surveillance and change monitoring	MDA Systems Ltd
	Application of Big Data analytics techniques to extracting geospatial intelligence from SAR imagery	MDA Geospatial Services Inc.
	Architecture innovations for analytics-ready data	UrtheCast Corp.
Complementary sensor exploitation	UrtheCast Corp.	
CAUSE	Acoustic Source for Ocean Propagation Experimentation	GeoSpectrum Technologies Inc
	Acoustic Array for Persistent Under-Ice Vehicles	GeoSpectrum Technologies Inc
	UUV: Fuel Cell and Suction Anchor	Cellula Robotics Ltd
TRG Analysis	All Domain Sensor Mix Evaluation Tool	MDA
	Context-aware sensor selection layered architecture for Arctic surveillance	Complex Systems Inc

ANNEX F – DETAILED FUNDING PROFILE

ADSA – Overall situation

as of: **2021-01-28**

	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21	TOTAL
APPROVED INITIAL BUDGET (Notionals)	3,000,000	15,000,000	30,000,000	42,000,000	43,000,000	9,100,000	142,100,000
Returned Funds at Q1		6,000,000					6,000,000
Returned Funds at Q2							0
Returned Funds at Q3	2,536,000	3,200,000	5,500,000				11,236,000
Returned Funds at Q4.2			2,600,000				2,600,000
Returned Funds at Q4.4			3,000,000				3,000,000
Returned Funds at Q4.5			840,000				840,000
Approved BUDGET (DND)	464,000	5,800,000	18,060,000	42,000,000	43,000,000		118,424,000
ACTUAL EXPENDITURES	783,380	5,269,538	18,907,072	42,383,181	43,423,866	4,799,916	115,566,953
Variance from Initial Budget	2,216,620	9,730,462	11,092,928	-383,181	-423,866	4,300,084	26,533,047
Variance in % from Initial Budget	73.9	64.9	37.0	-0.9	-1.0	47.3	18.7

Source: ADSA Financial Reports (2019/2020; 2020/21)

Note 1. Additional \$8.6 million was received through ADM(DRDC) L1 Business Plan for 2019/20. Note 2. 2020/21 actual expenditure is currently spent as of January 28, 2021. Note 3. A one-year extension (2020/21) was put in place to allow for the closure of certain projects and for the consolidation of results validation.

ANNEX G – INTERNATIONAL CONTEXT

Research relevant to Domain Situational Awareness in major defence R&D agencies of the Five Eyes nations

Australia



- **Department of Defence - Defence Science and Technology Group (DSTG)** provides scientific and technical support to defence operations and researches future technologies while advising on the purchase and use of equipment and capabilities, improving performance and reducing costs of assets.
- DSTG is concerned with future proofing, and has been involved in the research of OTHR, hypersonic technologies, unmanned systems, space systems and undersea warfare.
- DSTG work also incorporates imaging and remote sensing systems, hyper-spectral imaging, undersea surveillance via sensors and data fusion systems, ground-based space surveillance, signal and sensor processing, radar and sonar research and Artificial Intelligence-assisted detection and tracking.

New Zealand



- **Defence Technology Agency (DTA)** is an independent team of scientists, which serves as the chief providers of technological, scientific and research advice.
- A main area of research focus is maritime activity, particularly regarding navigation, domain awareness, marine disaster reduction, marine survival tactics, propulsion engineering and subsurface activity awareness. For example, the C4ISR (command, control, communications, computers, intelligence, surveillance and reconnaissance) project provides for underwater and over the ground ISR, strategic environmental monitoring, mission systems and battlefield awareness, sensing and surveillance, and space technologies.

United Kingdom



- **Defence, Science and Technology Laboratory (DSTL)** is an executive agency that is part of the ministry of defence of the United Kingdom.
- The purpose of DSTL is to enhance the influence of S&T on defence and national security across the government.
- Current research focuses on autonomous unmanned systems and future technologies related to propulsion, avionics, countermeasures, defensive air system structures and air platform vulnerability.

United States



- **Defense Advanced Research Projects Agency (DARPA)** is included under the newly structured Secretary of Defense for Research and Engineering.
- DARPA is focused on creating scientific breakthroughs by pursuing high-risk, high-impact research to test the operational feasibility of new technology. For example, Ocean of Things program seeks to strive for continuous maritime situational awareness via thousands of low cost floats which form a distributed sensor network.