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CANADIAN
ARMED FORCES

DND/CAF OPEN SCIENCE ACTION PLAN

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Canada 


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FOREWORD

Government agencies and departments are transitioning toward the practice of making scientific inputs, outputs and processes available to all Canadians with minimal restrictions. As Open Science evolves, so too must the Defence Team's culture around how to contribute to making science more available, while continuing to support scientists and research producers. The department must be ready to respond to any challenges posed by the transition to Open Science, and indeed must be prepared to take advantage of its opportunities. At the Department of National Defence and Canadian Armed Forces (DND/CAF) in particular, this also means taking the necessary research security precautions into consideration.

For these reasons, we are proud to present the DND/CAF Open Science Action Plan. This Plan will provide DND/CAF with a common, phased approach toward making its science and research data open and accessible to Canadians, while taking into account the unique position of the department in terms of safety and security concerns. It will support our commitment to foster openness and accountability, to provide Canadians with opportunities to access and participate in government science, and to keep the department at the forefront of international scientific developments.

The themes and actions outlined herein will help Defence scientists and researchers navigate a changing environment and ensure that they have the tools that enable appropriate participation in Open Science activities. The complexity and scope of Open Science at DND/CAF will require flexibility and a gradual approach to allow the department to respond to government priorities. We will bear these considerations in mind as we proceed and we will meet these objectives deliberately.

Thank you,

Isabelle Desmartis,

ADM (DRDC)



EXECUTIVE SUMMARY

Open Science is here. Consistent with the Government of Canada's (GoC) greater commitments to Open Government,¹ the aim of Open Science is to make Canadian federal science open to all, while maximizing benefits for the country's well-being, health and economy. The transition to Open Science will be implemented responsibly across federal departments, and will be guided by the Roadmap for Open Science (ROS)², which provides overarching principles and recommendations for Open Science activities in federal government science-based departments and agencies (SBDAs). Based on intra- and interdepartmental consultations with the science community and relevant stakeholders, which sought feedback on the challenges and opportunities of Open Science at DND/CAF, this departmental Open Science Action Plan was commissioned in alignment with the ROS recommendations and within the framework of Government of Canada policies and strategies (e.g. Directive on Open Government and Data Strategy Roadmap for the Federal Public Service).

Within DND/CAF, the responsibilities for Open Government are spread across LIs and ADM(DRDC)³ is the lead for Open Science. The purpose of this Action Plan is to provide DND/CAF with a common, phased approach towards making its science and research data open and accessible to Canadians (in conjunction with the required Recommendations in the ROS), while taking into account the unique safety and security considerations of the department. This action plan is limited to DND/CAF research outputs such as publications, data sets, and software code, either conducted or funded by the organization, and there is no new policy presented.

The actions outlined herein will help Defence researchers and scientists to address challenges and concerns, and harness the benefits and tools that enable appropriate participation in Open Science activities. Specifically, these key actions—including but not limited to addressing roles and responsibilities, publications, data management, software, partnerships, security and risk screening/assessments, training (security awareness), and departmental culture—are necessary to support producers of science, their managers and the department in the planning, production and release of Open Science documents and products. Accordingly, the actions are organized under six main themes—Governance, Enabling Authors, Enabling Data Producers, Enabling Software Developers, Collaboration, and Change Management.

The complexity and scope involved in implementing the OS Action Plan will require flexibility and a gradual approach to allow the department to respond to government priorities, to address new challenges or opportunities that may arise, to adapt to technological advances and/or to adjust as the departmental data strategy progresses. Therefore, this Action Plan has been drafted as an evergreen document to be revisited by the departmental Open Science Advisory Group ([OSAG] see details in the Governance theme) on an annual basis to monitor progress or adjust actions and targets as needed. Furthermore, at the time of its writing, additional engagements were being conducted to seek feedback across the department and will be used to inform an update to this Action Plan within six months following its release.

Research security continues to be a paramount concern within the Government of Canada and especially DND/CAF. The ongoing adherence to security of data, outputs, and software will impose constraints to the eventual implementation of Open Science. While this risk is identified in the Action Plan, the upcoming implementation process will further develop and demonstrate due diligence and accountability in this regard.

¹ About Open Government. <https://open.canada.ca/en/about-open-government>

² Roadmap for Open Science. https://www.ic.gc.ca/eic/site/063.nsf/eng/h_97992.html

³ DRDC – Defence Research and Development Canada



CONTEXT AND SCOPE

Canada has a longstanding commitment to openness and accountability—first established with the enactment of the Access to Information Act in 1983, followed by the Federal Accountability Act in 2006—as a cornerstone of a strong, modern and transparent democracy. In 2012, the Government joined the Open Government Partnership and in June 2013 it endorsed the G8 Charter on Open Data. The Government of Canada aims to meet the public’s expectations to broaden access to federal data and information, ensure transparency and accountability, and strengthen citizen engagement in government activities in a secure manner. This requires government departments and agencies to make their information resources that are eligible for release to be more easily discoverable and reusable, as aligned with ‘FAIR’ principles—Findable, Accessible, Interoperable, and Reusable.⁴

Open Science is a subset of Open Government, and its advancement across the GoC is guided by the Roadmap for Open Science, which was developed in the context of the Directive on Open Government, the Model Policy on Scientific Integrity, and the Data Strategy Roadmap for the Federal Public Service. In addition to outlining guiding principles and recommendations, the ROS acknowledges that the benefits of making science available to all are many, especially in terms of engagement with the public, analysis of scientific results, impact and acceleration of knowledge transfer.

Within DND/CAF, the responsibilities for Open Government are spread across L1s and ADM(DRDC) is the lead for Open Science. In addition, the departmental Defence Open Government Implementation Plan (2015), the Defence Open Government Plan (2019), and the DND/CAF Data Strategy (2019) are key drivers with which to align OS activities. The ADM(DRDC) letter to L1s: DND’s Commitment to Open Science (Aug 2018) and the DND/CAF Scientific Integrity Policy also outline commitments that are being considered.

Global trends in academic publishing and scientific output have been moving towards the ‘Open Access’ model for a number of years. Similarly, Government direction is clear—Open Science is moving forward, and it remains imperative that DND/CAF is prepared to meet its OS obligations in a responsible manner. The movement towards Open Science in the department is a good thing; it has many advantages for the innovation ecosystem across DND/CAF, and will provide opportunities to facilitate better data management and in-house data exploitation. Yet cultural, infrastructural, and security considerations will need to be addressed to support a smooth implementation of OS.

Security Implications

In light of the nature of the science done within the Defence Team, this Action Plan recognizes that security will take precedence over Open-by-default principles. This is recognized in the Framework for Implementing Open-by-Default with Federal Government Science guide, which outlines criteria on which decisions to withhold publication should be based. Furthermore, the GoC Research Security policy statements of 2020 and 2021 reinforce that Canadian research, including its open and collaborative research environment, are increasingly targeted by espionage and foreign interference activities. The risk of aggregation and the need to protect data and authors are exacerbated by OS. Therefore, it is important that DND/CAF remain vigilant to potential threats and take precautions such as conducting security risk assessments related to the release of information. DND/CAF partners such as the Canadian Forces National Counter-Intelligence Unit (CFNCIU) and the Director General Defence Security (DGDS) can provide guidance and training on these issues throughout the implementation process. Key questions around how to move forward persist, and this Action Plan sets the stage for a responsible and effective implementation of OS at DND/CAF, while maintaining a focus on accountability and due diligence in security and protection of research.

⁴ Directive on Open Government. <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=28108§ion=html>

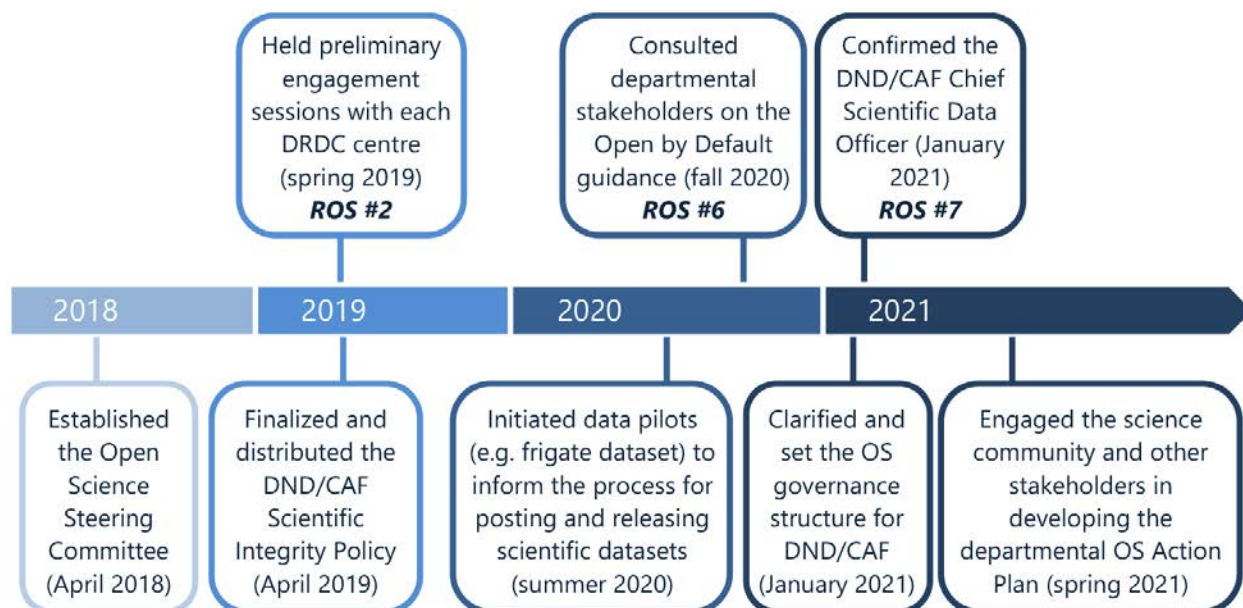
HOW WE GOT HERE

Since 2018, DND/CAF has made progress towards Open Science in the department, including achieving key milestones (see Figure 1 below) and responding to a number of recommendations identified in the Roadmap for Open Science as follows:

- Conducted intradepartmental consultations with the science community and other key stakeholders to establish an OS network, and informing the development of the Action Plan, including the challenges and the opportunities of Open Science. The first consultation period took place during spring 2019 and additional engagement sessions were held in spring 2021. *(ROS recommendation 2)*
- Consulted with DND/CAF stakeholders to submit feedback to A Framework for Implementing Open-by-Default with Federal Government Science⁵ developed by the Open-by-Default Framework committee led by the Office of the Chief Science Advisor. *(ROS recommendation 6)*
- Initiated and continues to promote coordination between the Open Data, Open Science and Science Data Management by designating a Chief Scientific Data Officer. *(ROS recommendation 7)*

The progress and activities undertaken to date have contributed to the development of the DND/CAF OS Action Plan and will remain critical to its successful implementation. *Throughout the process, efforts have been and will be made to ensure diverse representation and encourage underrepresented groups to participate.*

Figure 1: Key Milestones advancing Open Science in DND/CAF



⁵A Framework for Implementing Open-by-Default with Federal Government Science. http://www.ic.gc.ca/eic/site/063.nsf/eng/h_98201.html

VISION

DND/CAF science and research is open to the fullest extent possible, and readily and easily accessible to all Canadians.

PRINCIPLES

DND/CAF has identified four principles to achieve its vision, while also respecting and adhering to the Roadmap for Open Science principles of People, Transparency, Inclusiveness, Collaboration and Sustainability. Accordingly, DND/CAF will:

1. Adopt a pragmatic approach to making DND/CAF science open, while respecting security, privacy, ethical considerations, appropriate intellectual property protection, and a scientific value framework.
2. Respect federal open science guidance to ensure DND/CAF scientific outputs that are not subject to exemptions are Open-by-default and 'FAIR' (Findable, Accessible, Interoperable, and Reusable).



F indable
A ccessible
I nteroperable
R eusable

3. Align with the broader DND/CAF data, information, and knowledge management frameworks.
4. Embrace modern principles through the implementation of this Action Plan.



INTRODUCTION TO THEMES TO ACHIEVE THE VISION

Implementing OS in the department requires a phased approach organized by themes, which will enable collaboration amongst multiple groups with relevant expertise. Departmental stakeholders include the scientific community, and experts in information and knowledge management, data management, related departmental policies, scientific publishing, security/counterintelligence and others. Their collective knowledge has been critical to identifying the challenges, concerns and opportunities that have informed the development of this OS Action Plan, and will equally be necessary to ensure the successful rollout of the actions and implementation of solutions.

To organize its efforts towards achieving open science, DND/CAF has identified six themes that respond to the input and feedback identified by the aforementioned stakeholders, and that address and go beyond the recommendations outlined in the ROS. Each section of the six themes below provides their respective context and considerations, highlights targets, and identifies the actions to be undertaken including the associated leads or office of primary interest (OPI). The six themes are as follows: Governance, Enabling Authors, Enabling Data Producers, Enabling Software Developers, Collaboration, and Change Management.





THEME 1: GOVERNANCE

Open Science (OS) is a shared commitment between all stakeholders including those internal and external to the department, which will require alignment with federal directives and policies, and departmental initiatives relating to Open Data, Open Information and Open Government. An effective OS governance for DND/CAF will need to take these elements into account while addressing the structure and processes for decision making, accountability, and approval for both the development and implementation of the OS Action Plan. As the OS initiatives invariably involve multiple L1s across DND/CAF, either directly or indirectly, the department will need to work collaboratively to implement processes that are well-coordinated.

The current DND/CAF governance highlights the specific OS roles and responsibilities, as well as intradepartmental collaboration with leads and initiatives for Open Data and Open Government (see Annex C: DND/CAF Open Science Landscape). It also clarifies interdepartmental linkages with the Office of the Chief Science Advisor (OCSA) and other federal departments and agencies. Moving forward, the governance structure will require further review and modification to ensure effective implementation of the OS Action Plan with broad inclusion at both the intra- and interdepartmental level.

At an interdepartmental level, this will require ongoing coordination with the OCSA and other SBDA for alignment with GoC policies and initiatives. Further, and in order to determine what falls under the umbrella of OS, it will be necessary for the department to agree on a definition of what constitutes scientific outputs (see Key Definitions in Annex B), taking into consideration the fact that many L1s do not produce science as part of their primary mandates. This also means that it will be necessary to review and harmonize approval processes for OS, as well as the approval levels for those data or outputs that are deemed scientific.

Within the department, the governance structure will need to facilitate the mandate of the Chief Scientific Data Officer (CSDO) to ensure that proper consideration is given to scientific and research data when developing and implementing the departmental data strategy. In addition, ongoing coordination is needed amongst the CSDO, Chief Information Officer, Chief Data Officer, and related OS and Open Government Champions. And finally, meaningful engagement of departmental stakeholders – including the scientific community, experts in information and knowledge management, data management, related departmental policies, security risk assessments, etc. – at every stage of the process and achieving their buy-in is critical to the successful implementation of OS. The governance must enable their participation in identifying and implementing the actions identified for each theme within this DND/CAF OS Action Plan.



**ROS
Targets**

January 2021

Appoint a departmental Chief Scientific Data Officer to promote coordination between the Open Data, Open Science and Science Data Management

**Actions
[Leads/OPIs]**

1 - Appoint Chief of Staff (DRDC) as Chief Scientific Data Officer (CSDO) by January 2021. **[DM]**

*completed January 2021

2 - Refine DND/CAF OS governance including establishing/confirming the roles of advisory groups, implementation teams and other stakeholders needed to implement OS requirements by May 2021. **[CSDO]**

3 - Review/define approval authorities and conflict resolution processes for OS, taking into consideration the various functional authorities across L1s by December 2021. **[CSDO, CIO, CDO]**

4 - Develop a DND/CAF OS Implementation Plan—in alignment with the Data Strategy Roadmap and other related initiatives—to steer the work and monitor progress, including a defined structure for monitoring progress by January 2022. **[OSAG]**





THEME 2: ENABLING AUTHORS

This theme considers the actions required to facilitate the open publishing and release of federal science articles and publications. It is meant to ‘enable’ DND/CAF science authors by considering the full publication process and adjoining policies. In line with the ROS, it specifically focuses on externally peer-reviewed publications.

Publishing trends in many academic and scientific fields are changing. A number of publishers, libraries, and universities have come around to the benefits of Open Access publications, and many tenure committees and science-based organizations now actively encourage open publications.⁶ Some prestigious journals were hesitant about this transition at first, but are also following suit. Currently, an increasing number of scientific journals have begun to offer different levels of publishing access such as Green and Gold (see definitions below), and the number of Open Access journals is also increasing. The gradual acceptance of this change is on par with greater ‘openness’ in relation to the sharing economy and industries that utilize data, coding, and software, etc. Within the GoC, there is an obligation to move towards open publications but authors are still encouraged to look for well-established publishers (high impact factor, etc.) to maintain the reputation of SBDA in their mandate to deliver advice that is based on high quality peer-reviewed science. While this is not the only challenge, it should also be acknowledged that there is a cost associated with Gold access publishing in well-established publications, and this needs to be taken into budgetary considerations. The use of

pre-prints (see definition below) also needs to be clarified, as well as many other myths related to Open Access publications such as Open Access journals are of poorer quality than traditional subscription-based journals. Balancing these various, potentially conflicting requirements, will require flexibility.

The actions proposed in this theme seek to support and ‘enable’ DND researchers and scientists and other subject-matter experts who write articles and reports, to ensure the timely, secure and resource-effective, release of the outputs of defence science, either conducted or funded by the department. The Open-by-default policy mandates that scientific research outputs should be accessible when there is no justification for them to remain closed. OCSA—in collaboration with SBDA—has released guidance outlining criteria to help determine when documents should be kept private or confidential.⁷ The GoC Safeguarding Your Research portal⁸ and Safeguarding Science initiative⁹ also provide guidance on how to safeguard research and innovations, as well as raise awareness around risks. Although aimed at the private sector and academia, they can be leveraged by defence scientists and other subject-matter-experts to carry out due diligence before the release of scientific research outputs.

These guidance resources along with existing DND/CAF policies will be used to support authors through the implementation stage. For example, implementation will need to

⁶ Ellis, Lindsay. A Turning Point for Scholarly Publishing. The Chronicle, 2019. <https://www.chronicle.com/article/open-access-is-going-mainstream-heres-why-that-could-transform-academic-life/>

⁷ A framework for Implementing Open by Default within Federal Government Science. http://www.ic.gc.ca/eic/site/063.nsf/eng/h_98201.html

⁸ Safeguarding Your Research. https://www.ic.gc.ca/eic/site/063.nsf/eng/h_97955.html

⁹ Safeguarding Science. <https://www.publicsafety.gc.ca/cnt/ntnl-scrtr/cntr-trrrsm/cntr-prfrtn/sfgrdng-scnc/index-en.aspx>

consider the DND/CAF environment as described in the Defence and Security Science & Technology Strategy¹⁰, which clearly indicates that internally-delivered departmental science should focus on strategic, sensitive and classified elements, which may not be easily reconciled with open publishing. Ultimately, it is necessary to find a strategy that will enable the department to transition towards open-by-default while balancing costs and these other constraints. Socializing and incentivizing open access across the department will be key.

In addition, there may be existing policies and guidance documents that require a review and/or clarification to ensure alignment with the new OS directive. The Scientific Integrity Policy (SIP) may be an example as well as the DRDC Publishing Reference Manual (PRM), but others may come to light during the implementation process.

The actions below will help to clarify the current state of the department and determine a path forward that also considers existing ROS timelines and publishing industry trends. Since

many open access publications are relatively recent, a key consideration for DND/CAF will be to balance the requirements of maintaining a high level of scientific credibility through publication in well-established journals, and the need to publish science in open fora to the greatest extent possible, as early as possible in the research cycle. A schedule of progressive targets for open publishing will be needed to reach ROS targets in an effort to progress in a sensible way while observing industry trends, and to manage the associated costs.

Finally, publishing is tightly linked with the career progression of Defence Scientists and University Teachers, which remains an important consideration as the publishing strategy is developed. Scientists can be supported by ensuring that related policies and DND/CAF culture are aligned with these new requirements (see Change Management section for culture-related action items). Collaboration among publication offices, management, bargaining agents, and authors will be critical.

ROS Targets

January 2022

Ensure Federal Science articles are openly accessible

January 2023

Ensure Federal Science publications are openly accessible

Actions [Leads/OPIs]

1 - Build a strategy to maximize the extent to which DND/CAF's scientific publications are made "Open Access" – taking into account current baseline, publishing trends, GoC targets, and organizational needs – focused on new publications by March 2022. **[new OSAG implementation team]**

2 - Review DND/CAF policies, such as the Scientific Integrity Policy, and the DRDC publication system, to ensure they are aligned with the new GoC policies and directives on Open Science, and develop guidelines as needed by January 2022. **[COS]**

3 - Promote the use of pre-prints when appropriate through a communication campaign to bust myths surrounding pre-prints, and provide information on how to publish them by June 2022. **[EIC]**

¹⁰ Defence and Security S&T Strategy. <https://www.canada.ca/en/defence-research-development/corporate/publications/defence-st-strategy.html>



THEME 3: ENABLING DATA PRODUCERS

Open Data is an integral part of the Government of Canada's commitment to openness. The benefits of Open Data include support for innovation and research, leveraging information for consumers, and increased accountability. It will be important to remain cognizant that not all data can be open, for security, legal, privacy, and confidentiality related reasons, especially in the context of Defence science.¹¹

Within the context of Open Science, the release of scientific data contributes to the growth and sharing of knowledge, and is a critical component of the scientific process by enabling others to reproduce scientific results. It also allows for data from many sources to be integrated to produce new knowledge or enable new scientific discoveries. However, open access to these data also bears associated risks related to privacy, intellectual property, and/or artefacts/errors that could affect processed datasets. Within the Defence context, further considerations related to security and/or sensitivity are required. One such example relates to human-based data sets, for which new considerations will be required to the informed consent form submitted to various committees, such as the Human Research Ethics Committee (HREC) or other review boards at DND/CAF. Taking these elements into account, this theme highlights actions required to facilitate the release and posting of scientific datasets, including a framework for lifecycle data management, IT infrastructure and related tools, processes and guidelines, among other things.

The ROS acknowledges alignment with the Data Strategy Roadmap for the Federal Public Service to ensure that the open scientific information is "FAIR" (Findable, Accessible,

Interoperable, and Reusable). A pre-requisite for the implementation of FAIR data principles is strong data management practices, including annotation and curation to the most updated standards (e.g. current data and metadata standards). For data management processes to be effective, they need to be easy-to-use with clear guidelines on developing overarching data management plans including conducting risk assessments that detail how the data will be collected, organized, stored and access controlled (for unclassified, designated, and classified data) to help inform how, and whether the data can be shared.

The processes and tools required to prepare data for sharing will need to be documented and accompanied with suitable training material; this will be further explored under the Change Management theme. It is important to note that, like any research organization, DND/CAF constantly produces new systems and data types. A flexible evergreen approach towards data and metadata standards will be required, and the overhead necessary to apply, maintain and refresh these standards will need to be minimized.

Though critical to Open Science implementation, data management, information management, and the development of the IT environment necessary to enable the accessibility of science data lay beyond the scope of OS. As noted previously, this highlights the importance of aligning with the Defence Information Strategy, the DND/CAF Data Strategy and other GoC data-related initiatives which sets targets for the management of data towards a culture and mindset that views and treats data as an asset. DND/CAF needs to develop an IT environment to manage data at an institutional level,

¹¹ Open Data 101. <https://open.canada.ca/en/open-data-principles>.



which is broader than—but includes—research data that needs to be managed at all levels of security and/or sensitivity. Open science is highly dependent on this IT infrastructure and it is recognized that its development is a complex endeavor that will require time.

Given the multifaceted challenges in implementing Open Data, DRDC has initiated and is applying an incremental approach to data-sharing through the use of pilots (e.g. build a little, test a little). Having the science community, initially through the DRDC centres, involved early on in identifying and posting challenging datasets will support an iterative progression as the organization learns from these pilots and

is able to introduce rigor to the requirement sets for future data management infrastructure. These pilots will also be a key component to building a data culture and an Open Science culture within the various science-based teams throughout DND/CAF.

Moving forward, it will be necessary to provide additional guidelines on what OS data encompasses to fully define and understand constraints such as cost, information content, etc. In addition to building data management and data sharing processes is the need to increase data literacy across the organization to understand challenges and inform internal solutions to better exploit data.

ROS Targets

January 2023

Develop phased plan to implement strategies and tools to ensure interoperability of scientific and research data, and metadata standards

January 2025

Fully implement strategies and tools to ensure interoperability of scientific and research data, and metadata standards

Actions [Leads/OPIs]

1 - Establish guidelines on releasability, taking into account the costs (financial and HR), security risks (including from aggregation), and scientific value of datasets by June 2022. **[OSAG]**

5 - Informed through a series of data pilots, develop and document processes to streamline the posting and release of scientific datasets by January 2025. **[OSAG data pilots team]**

2 - Identify Open Data requirements as part of the broader DND/CAF science data management framework to be developed, and implementation strategy by December 2023. **[CSDO]**

6 - Identify process requirements specific to human-based datasets including privacy and information security considerations by December 2023. **[HREC + other review boards and OSAG data pilots team]**

3 - Establish a metadata governance framework in alignment with existing policies, directives and standards, and with a minimum set of metadata standards by January 2024. **[Mgr KM]**

7 - Identify minimum requirements for verification and validation (V&V) by March 2023. **[OSAG]**

4 - Create a Community of Practice to maintain and evolve metadata standards in a coherent way by June 2022. **[CSDO]**



THEME 4: ENABLING SOFTWARE DEVELOPERS

This theme considers the actions required—whether regarding tools, processes, etc.—to facilitate the release and posting of software. Software is not explicitly included in the ROS but is understood to be part of Open Data. The Treasury Board Secretariat’s Directive on Service and Digital highlights “work in the open by default” as one of the government’s digital standards, and its Appendix A: Mandatory Procedures for Enterprise Architecture Assessment states that “by default any source code written by the government must be released in an open format” (section A.2.3.8.3).¹² Again, within the DND/CAF context, considerations relating to security and/or sensitivity must also be taken into account particularly for collaborative environments in which software is sometimes shared and developed.

Open Source software refers to software code that is available for others to view, copy, and modify for their own purposes or the benefit of the collectivity. It is used across the world by small and large companies, organizations and governments, and has been used in the Government of Canada for more than twenty years.¹³ It is recognized to facilitate collaborative learning and exchange, encourage sharing of standards, increase interoperability, and improve the quality of solutions generated through a diversity of ideas and communities that form around a shared challenge.¹⁴

There is a lot of interest from the DND/CAF science community in sharing software while in development in order

to exploit the benefits of this collaborative work environment. Therefore, the requirement for verification and validation (V&V) may not be the same as for data. This interest for sharing of software triggers the need to develop and provide best practice guidance for software developers.

Furthermore, it will be important to determine the scope of scientific software, i.e. where do we draw the line between source code, executables, models, analysis scripts, and the level of maturity required to publish. The processes required to share software will also need to be determined and streamlined, taking into account the reality that software is often published in parallel with data and/or scientific publications.

¹² Directive on Service and Digital - Appendix A: Mandatory Procedures for Enterprise Architecture Assessment. <https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=32602>.

¹³ Open First Whitepaper: Open Source Software Use. <https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/open-source-software/open-first-whitepaper/open-first-whitepaper-use.html>.

¹⁴ Boots, Sean and Ruihley, Josh. Why open source matters. <https://digital.canada.ca/2020/02/24/why-open-source-matters/>.



ROS Targets

January 2025

Fully implement strategies and tools to ensure interoperability of scientific and research data, and metadata standards

Actions [Leads/OPIs]

1 - Define scope of open software by June 2022. **[new OSAG implementation team]**

2 - Develop streamlined processes and related guidance documents to post open software or contribute modifications to existing code repositories, in alignment with the DND/CAF Data Strategy as needed by January 2025. **[OSAG data pilots team]**

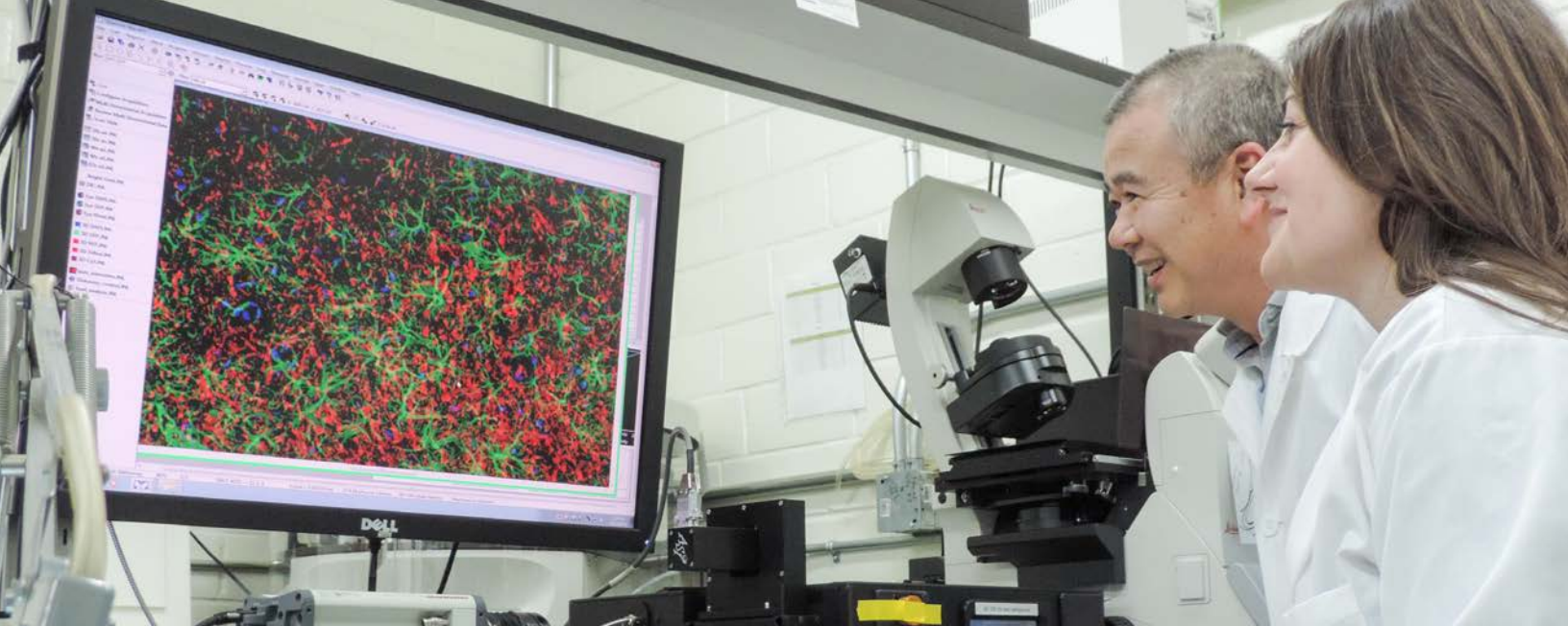
3 - Develop process for controlled goods review of software by June 2023. **[COS/Senior Security Mgr]**

4 - Promote a software developer community to establish/document best practices, and provide formal/informal training and skills development by January 2023. **[DGRDSE]**

5 - Identify requirements for verification and validation (V&V) by January 2023. **[OSAG]**

6 - Investigate the risks and mitigation strategies associated to software collaborative environments by June 2022. **[COS]**





THEME 5: COLLABORATION

The nature of Open Science is dynamic and evolving. It will involve collaboration with many other government partners and jurisdictions, which speaks to the need for a coherent OS strategy for Canadian science more broadly. Continuous monitoring of changes to Open-Access publishing standards, the moving dynamics of coding and software development and sharing, the ever-changing technological landscape and the evolving international context of Open Science will remain important in ensuring that federally supported science continues to keep pace with domestic and international developments.

At the domestic level, ongoing consultation and collaboration among science practitioners, managers and funders from across science-based departments and agencies, and indeed across the research communities in all provinces and territories will be a key part of making progress on Open Science activities. Interdepartmental cooperation on key issues such as IT infrastructures, embargo licenses on intellectual property, peer review processes, information aggregation and metadata standards, official languages, and more, will be important to tackle the complex nature of OS in a coherent manner.

The department can also share knowledge and learn from pilot projects, from phased approaches to open access publishing, from data management techniques, and from broader discussions on security and privacy that other agencies and departments are pursuing. Further partnerships with the

federal granting agencies (e.g. through the Canada Research Coordinating Committee), and major research universities across the country will ensure that DND/CAF is at the forefront of best-practices in OS. This engagement will also enable the department to observe and explore other open discovery concepts such as citizen science, or open innovation for all, which ultimately can increase knowledge mobilization and reduce delays in the sharing and re-using of scientific information, i.e. as a new way to drive innovation.

DND/CAF already has access to well-developed scientific networks both nationally and internationally that could further bring value to the implementation of Open Science (e.g. collaborative development of metadata standards, research security). More can be done to engage and exploit these networks effectively for the purpose of progressing the implementation of OS. Collaboration internal to DND/CAF is also required. Due to the interwoven responsibilities for OS, the various L1s will need to work together to ensure its successful implementation. By building synergies with international and domestic OS movements and implementing cohesively across the department, DND/CAF will help to shape the Canadian vision of Open Science.



**ROS
Targets**

December 2021

Contribute DND/CAF input to the Open Science strategy for federally funded research conducted outside of federal government agencies and departments

**Actions
[Leads/OPIs]***

1 - Coordinate internally on the implementation of Open Science, through the OSAG, the Defence Data Management Board, and additional WGs/committees as required. **[CSDO and L1 representatives]**

3 - Foster interoperability through participation in other national and international initiatives related to DM/IM (e.g. NATO sponsored workshops and activities). **[CSDO and L1 representatives]**

2 - Share and learn from others through participation in cross-government initiatives (DG OS council, Metrics WG, etc.). **[CSDO and L1 representatives]**

*These actions are ongoing throughout the implementation of Open Science, and have no defined deadline.





THEME 6: CHANGE MANAGEMENT

The directive on Open Science is cross-government and will affect all science workers. It will result in gradual changes to the ways in which scientific outputs are created and shared in all departments, including DND/CAF. Given that the scientific community can be protective of their data and science before it is published, reluctance to these changes is expected. This has been borne out in many academic communities struggling with the transition to Open Access publications. Within the defence environment, there is an additional layer of resistance for valid security reasons, which needs to be considered at all steps. Further, not all science workers may be aware of the full scope of OS, nor the timelines set by the federal government. Steps must be taken to address and clarify this across DND/CAF.

These different factors require active management of the culture change through the implementation of Open Science at DND/CAF from building awareness and developing a comprehensive communications plan, to determining training requirements, implementing related tools, to highlighting successes.¹⁵ Incentivizing the operationalization of Open Science will also require careful consideration of the duality between OS requirements and the high-level principles of the DND S&T strategy, which underlines that internal science should focus on strategic, sensitive and classified topics, seemingly in contradiction with OS goals. This theme discusses the ways to facilitate an OS culture change across the department.

In many cases, Open Science risks being seen as another process imposed on a community that is already subject to

layers of approvals and bureaucracy to complete its work. In the transition to a standardized and institutionalized means of sharing scientific data, it will be important to use the Open Science directive as an opportunity to put enablers in place, such as effective and easy-to-use data management practices. Meaningful improvements to current practices at DND/CAF are necessary, and will be an asset to scientists and researchers. Another enabler resulting from OS compliance would be the development of a broad data archiving capability (for all types of data) that will allow data producers to maintain situational awareness of the organization's science data holdings and, an easier means by which to share science knowledge amongst science workers. As a final example, considerations around instituting the fund currently piloted to cover the publication costs associated with Open Access publication would enable authors to publish their work, reach a larger audience for a higher impact of publication and avoid the need to impact project funding with expenses related to publication.

The transition to an Open Science culture will also require consideration of three key elements. First, employees must understand that 'Open-by-default' does not mean 'Open without exception'. As a defence organization, employees routinely work with sensitive or classified data for which there will be no reasonable expectation that they will be made available to the public, such as in the case of those exempted under the Access to Information Act.¹⁶ Hence, OS does not put DND/CAF into a position where it is forced to open data that should be kept protected. Second, the department is committed to a pragmatic approach to complying with Open Science—one that minimizes the time and effort

¹⁵ Phases proposed within the ADKAR (Awareness, Desire, Knowledge, Ability, and Reinforcement) model, a framework proposed by the change management company, Prosci.

¹⁶ Access to Information Act (R.S.C., 1985, c. A-1). <https://laws-lois.justice.gc.ca/eng/acts/A-1/>.

required to make publications, whether manuscripts, software, or datasets useful and open to others. Finally, as mentioned above, OS can provide DND/CAF with an opportunity to establish an upgraded state-of-the-art archiving capability for its data that the scientific community has long desired. Open Science is thus an opportunity to catch up.

These changes represent a new and additional step in improving the science process at DND/CAF. Optimal compliance with the OS directive will depend on culture change and a shared understanding that both science workers and the organization benefit from the release of the department's scientific data. The actions described below suggest ways in which to accomplish this.

ROS Targets

December 2020

Contribute to the federal framework identifying criteria for when restricting access to scientific research outputs is warranted, in order to enable the 'open by default' model.

January 2021

Adopt an Open Science approach to federally funded scientific and research outputs.

Actions [Leads/OPIs]

1 - Develop a communications strategy to build awareness and enthusiasm around OS, and educate staff on the full scope and requirements related to OS, including periodic/regular communication on progress and implementation by June 2021. **[CSDO]**

2 - Consult with bargaining agents ahead of, and throughout, the implementation process on issues such as IP, academic freedom, and resourcing. **[CSDO]**

3 - Build an OS "Community of Practice" to foster continued engagement with the scientific community in defining open science requirements by September 2021. **[OSAG]**

4 - Appoint Champions (one within each DRDC centre and DGMPPRA and a central Champion for other stakeholders) with the right technical skills to be responsible for helping science workers make DND/CAF science open, using whatever tools are provided for them until they can do it themselves by January 2022. **[Centre Directors, DGMPPRA, COS]**

5 - Advance compliance with Open Science by ensuring that open scientific datasets should be published along with the open publications derived from the analysis by June 2022. **[OSAG]**

6 - Review the DS SAS characteristics for alignment with OS by the next DS SAS update. **[DGRDPA]**

7 - Identify any new skills needed by scientific staff to be compliant with the OS directive, and design appropriate training and guidance documents to support that on an ongoing basis. **[CSDO]**



REPORTING

Consistent implementation of cross-departmental metrics facilitates collaboration and assists in the dissemination of best practices and innovation. Accordingly, DND/CAF will participate with OCSA and other SBDAs in collaborative efforts to establish OS metrics. This will include consideration of commitments set by the National Action Plan on Open Government, which provides metrics and related indicators, and tracks progress made federally. These indicators provide a basis for assessing SBDAs' progress in implementing Open Science and identifying opportunities for further action.

Progress of Open Science implementation at DND/CAF will also be monitored and tracked by the OSAG and the departmental CSDO—specifically the targets and actions and their respective timelines set herein—including consulting with ADM(RS) on the development of metrics. Departmental OS progress will be reported to OCSA as appropriate and as reporting structures are further determined over the next few months.

CONCLUSION

This Action Plan has outlined themes and specific actions that will help Defence researchers and scientists to address challenges, and harness the tools that enable appropriate participation in Open Science activities. This information and recommendations are necessary to support producers of science, their managers and the department in the planning, production and release of Open Science documents and products, as we transition more fully to OS, while taking into account important security implications of the department.

Given the complexity involved in implementing OS, this Action Plan has been drafted as an evergreen document to enable updates to existing actions and targets or inclusion of new ones in response to government priorities and policies, to new challenges or opportunities that may arise, to technological advances and/or to progress of the departmental data strategy. Updated versions will be published and/or shared interdepartmentally on an annual basis or other agreed upon timelines to be determined. The first update to this Action Plan is anticipated for fall 2021 following completion of the engagement with all L1s and with the Royal Military Colleges and the Canadian Forces College.

¹⁷ Action Plan on Open Government. <https://open.canada.ca/en/content/canadas-2018-2020-national-action-plan-open-government>

¹⁸ Commitments can be searched and sorted on the National Action Plan on Open Government Tracker, with Open Science set under Commitment 5. https://search.open.canada.ca/en/nap/?sort=score%20desc&page=1&search_text=

ANNEX A: LIST OF ACRONYMS

| | |
|---------|---|
| CAF | Canadian Armed Forces |
| CDO | Chief Data Officer |
| CFNCIU | Canadian Forces National Counter-Intelligence Unit |
| CIO | Chief Information Officer |
| COS | Chief of Staff |
| CSDO | Chief Scientific Data Officer |
| DG RDSE | Director General R&D Science and Engineering |
| DG MPRA | Director General Military Personnel Research and Analysis |
| DG RDPA | Director General R&D Policy and Advice |
| DGDS | Director General Defence Security |
| DND | Department of National Defence |
| DRDC | Defence Research and Development Canada |
| DS SAS | Defence Scientist Salary Administration System |
| EiC | Editor in Chief |
| FAIR | Findable, Accessible, Interoperable, and Reusable |
| GoC | Government of Canada |
| HREC | Human Research Ethics Committee |
| IT | Information Technology |
| KM | Knowledge Management |
| OCSA | Office of the Chief Science Advisor |
| OPI | Office of Primary Interest |
| OS | Open Science |
| OSAG | Open Science Advisory Group |
| PRM | Publishing Reference Manual |
| ROS | Roadmap for Open Science |
| SBDA | Science-based Departments and Agencies |
| SIP | Scientific Integrity Policy |
| S&T | Science and Technology |
| V & V | Verification and Validation |



ANNEX B: KEY DEFINITIONS¹⁹

Access restrictions: Security identification and categorization that ensures that appropriate safeguards are applied to mitigate security risks to the confidentiality, integrity, or availability of information.

Data: Reinterpretable representations of information in a formalized manner suitable for communication, interpretation, or processing.

Data Management: The development, execution, and supervision of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data assets throughout its lifecycle.²⁰

Federal science articles: Scholarly articles authored or co-authored by federal scientist(s) or researcher(s) in peer-reviewed academic journals.

Federal science publications: Scientific communications that scientists and researchers use to share their work. These include research or scientific reports, monographs, edited books, book chapters, conference proceedings, conference papers, conference contributions, posters, plain language summaries and technical scientific products. These publications have been validated by a peer-review process.

Green/Gold Open Access Publications: Gold open access is where an author publishes their article in an online open access journal. In contrast, green open access is where an author publishes their article in any journal and then self-archives a copy in a freely accessible institutional or specialist online archive known as a repository, or on a website.²¹

Open Access Publications: (OA) refers to freely available, digital, online information. Open access scholarly literature is free of charge and often carries less restrictive copyright and licensing barriers than traditionally published works, for both the users and the authors.²²

Open data: structured data that is machine-readable, freely shared, used and built on without restrictions.

Open government: A governing culture that holds that the public has the right to access the documents and proceedings of government to allow for greater openness, accountability, and engagement.

Open information: Unstructured information that is freely shared without restrictions.

Open Science: The practice of making scientific inputs, outputs and processes freely available to all with minimal restrictions. Open Science is enabled by people, technology and infrastructure. It is practiced in full respect of privacy, security, ethical considerations and appropriate intellectual property protection.

Open Source Software: Software with its source code made available with a license in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose.²³

Pre-print: A pre-print is a manuscript prepared for publication as a journal article that gets shared prior to peer review by a journal.

Peer Reviewed Publications: Articles that are written by experts and reviewed by several other experts in the field before the article is published in the journal in order to ensure the article's scientific quality and integrity.

Science: The pursuit and application of knowledge and understanding of the natural world through application of one or more elements of the scientific method. In the context of this roadmap, it is understood to include both fundamental and applied natural, physical, biomedical and social science, as well as engineering and mathematics.

¹⁹ A Definitions of various terms of relevance to Open Science are reproduced here from federal guidance documents, i.e. ROS, Directive on Open Government, A framework for Implementing Open by Default within Federal Government Science.

²⁰ Annex A: Definitions. <https://www.canada.ca/en/department-national-defence/corporate/reports-publications/data-strategy/annex-a-definitions.html#fn>

²¹ Publisso. https://www.publisso.de/en/no_cache/advice/publishing-advice-faqs/difference-between-gold-and-green-open-access/

²² Cornell University. <https://guides.library.cornell.edu/openaccess>

²³ Open Source Software. <https://www.canada.ca/en/government/system/digital-government/digital-government-innovations/open-source-software/open-first-whitepaper/open-first-whitepaper-use.html>



Scientific research outputs: these include but are not limited to (i) peer-reviewed science articles and publications, (ii) scientific and research data and (iii) public contribution to and dialogue about science.

Scientific and research data: Data that include, but are not limited to, observational, monitoring, operational, modelling and simulation, risk assessment, survey and surveillance, research and development and technology innovation data.

Structured information: Digital information residing in fixed fields within a repository.

Technology: The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society and the environment, drawing upon such subjects as industrial arts, engineering, applied science and pure science.

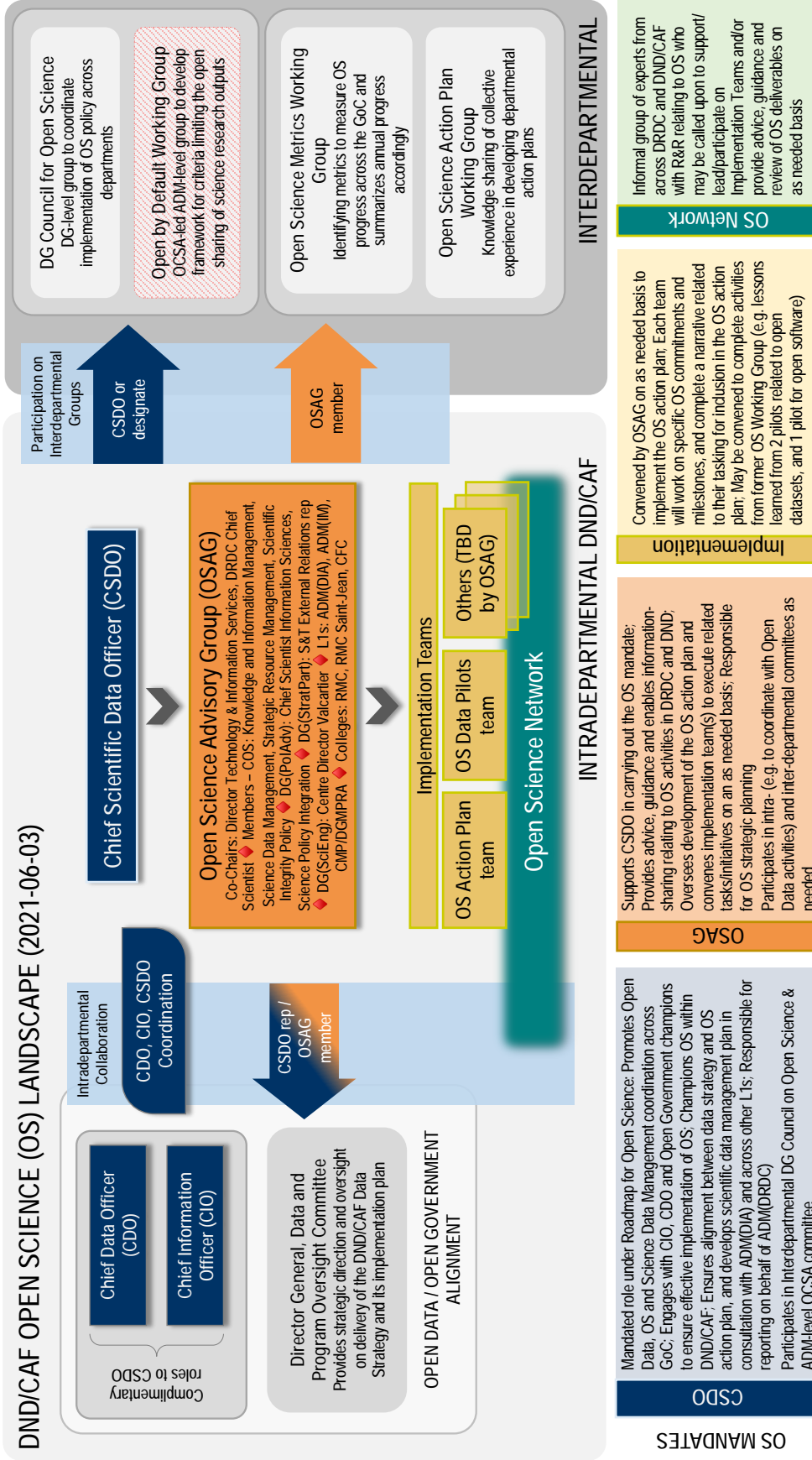
Unstructured information: Digital information that is often created in free-form text using common desktop applications such as e-mail, word-processing, or presentation applications.

Verification and Validation: V&V is the process of checking that a software system meets specifications and requirements so that it fulfills its intended purpose. It may also be referred to as software quality control.²⁴

²⁴ Wikipedia. https://en.wikipedia.org/wiki/Software_verification_and_validation



ANNEX C: DND/CAF OPEN SCIENCE LANDSCAPE



OS MANDATES