



NDSF Summit 2020

Summary and Recommendations

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Executive Summary

This document summarizes the input from attendees of the [2020 National Data Services Framework \(NDSF\) Summit](#), including [outputs from three breakout discussion groups](#), a [collaborative Notes document](#), and feedback on the [Kanata Declaration](#) (which emerged from the 2019 NDSF Summit). Some of the elements reflected here are also highlighted in the updated [2020 version of the Kanata Declaration](#). Participants at the 2020 Summit represented a broad range of stakeholders, including academic institutions, government agencies, funders, policymakers, researchers, research support and digital infrastructure providers, and the private sector. These stakeholders are important voices in the development of a National Data Service (NDS) in Canada and should be consulted on an ongoing basis moving forward.

A background of the NDSF Summit highlights the event's impetus as a component of a three-layered approach to the development of Canadian NDSs: a conversational context, best-practices standards-based context, and a suite of interoperable services and resources. The 2020 NDSF Summit, third of its kind, was an opportunity to view the Canadian landscape via all three lenses, and the following Summit is expected to delve further into this approach. A linked list of presentations and background material from the 2020 Summit is provided.

Attendees participated in three breakout discussion groups and were asked to consider the requirements for an NDS, provide examples of existing, emerging, and needed NDSs, and identify priorities for Canadian research data management (RDM) moving forward (the next 6-12 months, 2-5 years). Overarching themes emerged, including the importance of communication and training, the need for further alignment and integration of Canadian and international NDSs, centralization and federation of RDM components, balance between domain-specific and domain-agnostic services, and challenges of long-term data preservation and management of sensitive data.

Participant feedback was then categorized according to a six-part model for facilitation adapted from the European Open Science Cloud (EOSC): Architecture, Data, Services, Access & Interface, Rules, and Governance. Sections for each of these "lines of action" feature more detailed summaries of breakout discussions and emerging themes. These themes are also expressed through a [visualization](#) which adds Training and Communication as cross-cutting categories. A linked list of NDSs highlighted in the text and breakout sessions is provided.

Finally, overarching recommendations based on collective participant input from the 2020 Summit discussions were extracted and listed by broad stakeholder groups, targeting all stakeholders, researchers, research funders, universities and research centres, government departments and agencies, repositories and publishers, and RDC, the [Portage Network](#), and the [New Digital Research Infrastructure Organization](#) (NDRIO). These recommendations are ultimately intended to facilitate researcher adoption of best practices in data management throughout the research lifecycle, so while they are addressed primarily at the stakeholder communities that support researchers, the goal with all is to see benefit to researchers.

Background of the NDSF

The NDSF Summits are one element in a host of components that support a three-layered approach to the development of National Data Services (NDSs) in Canada that includes:

1. a conversational context;
2. a best-practices standards-based context;
3. a suite of interoperable services and resources.

The 2020 Summit was the first opportunity to view the Canadian landscape via all three lenses in the same two-day Summit, and we hope that the result leads to a Summit that dives even further into the details of this approach. With that in mind, this is also the first time we will make recommendations for activities over the next 8-10 months, leading into a 4th Summit which we anticipate will be even more of a working meeting.

This is the 3rd NDSF Summit, held in February 2020 in Kanata, Ontario: the 1st Summit took place in September 2017 ([EN](#) | [FR](#)), and was held in conjunction with the Research Data Alliance (RDA) Plenary in Montreal, Quebec; the 2nd Summit was held in February 2019 ([EN](#)), also in Kanata.

The 3rd Summit consisted of a series of presentations highlighting the state of NDSs in the Canadian landscape, along with an update on the European Open Science Cloud (EOSC) project. The presentations were fed into small group discussions in three separate Breakout sessions: it is the outputs of those discussions that are the focus of this Summary document. In addition, the [Kanata Declaration](#) that emerged from the conversation at Summit 2, [has been updated](#) to reflect the evolving national research data landscape.

Participants at the 2020 Summit represented a broad range of stakeholders, including higher education institutions, government agencies, funders, policymakers, researchers, research support and digital infrastructure providers, and the private sector. These stakeholders are important voices in the development of NDSs in Canada, and by presenting their collective input in this document, we hope to ensure they are heard as well as consulted on an ongoing basis moving forward.

Presentations and Background Material from NDSF 3

Presentations

1. 2020 National Data Services Framework Summit: <https://doi.org/10.5281/zenodo.3671964>
2. The Changing World of Human Genomic Data Sharing: <https://doi.org/10.5281/zenodo.3671990>
3. The Adaptive Immune Receptor Repertoire (AIRR) Data Commons: iReceptor and the AIRR Community: <https://doi.org/10.5281/zenodo.3671996>

4. Scholars Portal activities within the Canadian RDM landscape:
<https://doi.org/10.5281/zenodo.3672033>
5. Portage Network - Update on Progress and Transition:
<https://doi.org/10.5281/zenodo.3672038>
6. It Takes More Than a Village: Lessons on Building Global Research Commons:
<https://doi.org/10.5281/zenodo.3672048>
7. BOLD & mBRAVE: Purpose-Built Research Data Platforms in the Biodiversity Domain:
<https://doi.org/10.5281/zenodo.3672057>
8. Building Robust Governance for Digital Research Platforms:
<https://doi.org/10.5281/zenodo.3672060>

Background Material

1. Kanata Declaration 2019 Version [[EN](#) | [FR](#)], [Draft 2020 Version](#)
2. Kanata Declaration 2020 Version [[EN](#) | [FR](#)]
3. Data Management in Canada: A Backgrounder [[EN](#) | [FR](#)]
4. [Data Management Roadmap 2019-2024](#)
5. RDC Roadmap [[Updated Map](#)]
6. [Raw Transcribed Breakout Session notes from NDSF Summit 2020](#)
7. [Google Documents Notes document from NDSF Summit 2020](#)

Overarching Themes from NDSF 3

Attendees participated in three breakout sessions and were asked to consider the following topics:

1. requirements for a National Data Service (NDS);
2. examples of NDSs (existing, emerging, and needed);
3. priorities for research data management (RDM) moving forward (the next 6 and 12 months, 2 and 5 years).

As the RDM ecosystem continues to evolve, and Canadian stakeholders anticipate further alignment and coordination under the [New Digital Research Infrastructure Organization](#) (NDRIO), overarching themes and concerns emerge as most relevant to progressing NDSs in Canada.

First and foremost, the importance of **communication and training** emerged across all three breakout sessions. Participants expressed a desire for a robust and transparent communication plan that would clearly articulate the function, structure, and value of NDRIO. Consultation and outreach to understand stakeholder needs, and ongoing engagement and discussion with the RDM community at large was also encouraged in order to build credibility and trust, and to continually communicate the developments of the RDM ecosystem to researchers, other stakeholders, and the general public. Improved communication would also lead to better

transparency for RDM entities in their policies, decision-making, and financial management, which was also a recurring issue raised by participants.

Sufficient **training** opportunities were deemed necessary to advance the mission of NDRIO, and to strengthen RDM services nationally. Participants discussed 'train-the-trainer' and national implementation teams as two models that would maximize the impact of training opportunities across institutions. A national training program that serves as scaffolding for local skills development was suggested as an efficient method of encouraging and supporting education of actors across all RDM support units. In the long-term, further training paired with recognition, rewards and certifications could lead to better retention of highly qualified personnel (HQP), which is beneficial to organizations of any size.

Participants highlighted the need for further **alignment and integration** of organizations and services, not only Canadian entities under NDRIO, but also of Canadian organizations and services and their international counterparts. Determining how these partners in the RDM ecosystem fit together at all levels - local, regional, national, international - was deemed an important step in furthering collaborative innovation, improving RDM support, and reducing overlap and duplication of efforts. An ideal system, according to participants, consisted of local provision of services supported and structured through a national framework that is linked to and influenced by international standards and counterparts. For example, active Canadian participation on international standards bodies was suggested as one method of global integration, and this is highlighted by stakeholder engagement on organizations such as [CoreTrustSeal](#), [ISO](#), [RDA](#), and others. These and other efforts provide Canada with a strong unified voice on the international stage.

Related to this discussion of alignment and integration are themes of **centralization and federation** of a suite of institutionally, regionally and nationally based components of RDM: architecture, infrastructure, data and metadata standards, services, repositories, access, interfaces, rules, and governance. Participants expressed interest in a national federated RDM architecture integrated with local infrastructure that would provide effective access to resources, support, and services. This is paired with the repeated request for a national registry or knowledge base of the entire RDM ecosystem - organizations, services, tools, stakeholders - as a searchable resource portal. NDRIO was frequently mentioned as the obvious catalyst for this kind of broad national centralization.

Participants recognized the need for **balance between domain-specific and domain-agnostic services**. Services and standards that provide sufficient specificity for managing data within individual domains are equally as important as centralized and federated services and infrastructure that provide universal discoverability and access. Accommodation of all sectors and domains was also noted as important both in terms of national architecture and in diverse inclusive representation in governance bodies. In accommodating all sectors and domains, participants want to see common ground in the RDM ecosystem established through universal terminology, common data models and practices, baseline standards and policies, all while still exhibiting flexibility that would allow multidisciplinary integration, particularly in architecture, services, interfaces, and rules.

There is demonstrated concern over the challenges of **long-term preservation** of data and management of **sensitive data** (e.g. data that must be protected against unwanted disclosure). Amongst the recommendations for NDSs, sustained archival storage was one of the more frequently cited gaps, with development of a Canadian data preservation infrastructure as a core recommendation. RDM services and repositories with the capacity to manage sensitive data were also identified as a gap in the current ecosystem (e.g. access control, sufficient security, knowledgeable support personnel, etc.), as well as additional services focused on Indigenous data, including platforms, repositories, standards, and vocabularies. These focused services could be achieved through ongoing meaningful consultation with First Nations, Métis, Inuit and broader global Indigenous communities to determine exact needs. Identity management, namely the use of persistent unique identifiers (PIDs), was also prevalent across breakout responses.

Action Themes from NDSF 3

At the NDSF Summit in January 2019, RDC proposed a model for facilitation with the community, based on the work of the [European Open Science Cloud](#) (EOSC). The [EOSC Model](#) was developed in March 2018 by the EOSC community to focus discussions on key layers in the RDM ecosystem, and defines 6 “lines of action” for this important pan-European research infrastructure. The version of the model shown below was adapted for the Canadian context, and was used in the 2019 CANARIE RDM Workshop, and both the 2019 and 2020 NDSF summits. The 6 “lines of action” were used to categorize the presentations of the 2020 NDSF Summit and are similarly used in this summary to categorize participant feedback from the breakout group sessions.

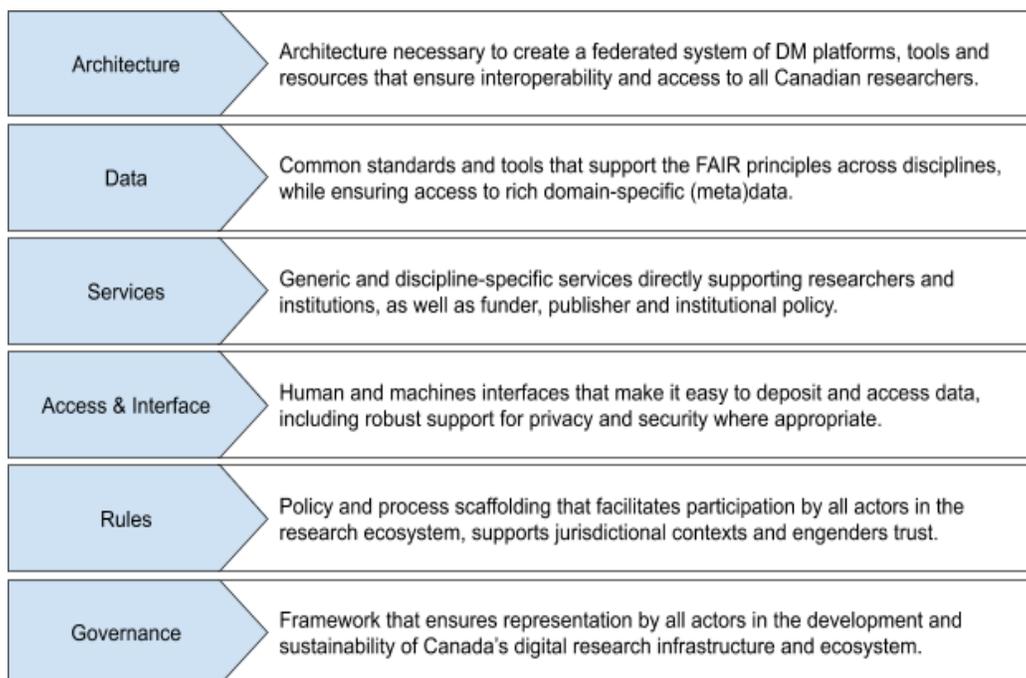


Fig. 1 - The EOSC Model adapted for the Canadian context

Architecture

According to the adapted 6-part model, architecture is defined as *the architecture necessary to create a federated system of DM platforms, tools and resources that ensure interoperability and access to all Canadian researchers*. Participants indicated that a user-centred design approach should be employed when creating any system, tool, or resource, and that accommodation should be made for all sectors: academia, provincial and federal science, citizen science, and private entities. Participant responses described the ideal national data service as a centralized federated architecture with local infrastructure and data hosting, made accessible through an API defined by common standards. This commonality would extend to open data repositories and (meta)data transfer infrastructure, complemented by robust and interoperable repository components. Centralization of metadata and unique identity standards would enable improved interoperability across the system, and technology standards in ethics, privacy, security and accessibility would further reinforce a quality federated system.

Data

According to the adapted 6-part model, data is defined as *the common standards and tools that support the [FAIR principles](#) across disciplines, while ensuring access to rich domain-specific (meta)data*. Participants deemed the use of a universal terminology with multilingual support as important to data standards and tools, improving access and interoperability of national services. Users of Canadian NDSs should be consistently supported in both English and French, and ideally in First Nations, Métis, and Inuit languages as well. A popular suggestion was the development of common data models that could be integrated with domain-specific (meta)data standards to serve data across disciplines. Participants were also in favour of supporting community efforts to develop domain-specific standards and tools that would allow heterogeneous data input and uniform data output. The importance of discoverability was consistently expressed, as well as the related importance of PIDs, such as DOIs, in supporting [FAIR principles](#) (meaning data should be Findable, Accessible, Interoperable, and Reusable).

Existing standards and tools were highlighted as serving some of these purposes, such as [ORCID-CA](#), [DataCite Canada Consortium](#) (DOIs), [Research Organization Registry](#) (ROR), and [Altmetric](#). Emerging NDSs under this category further reflect the importance of persistent identification, such as the [Research Activity ID](#) (RaID), as well as the need for multilingual support. Indigenous data standards and ontologies were also identified as emerging, such as the [Traditional Knowledge \(TK\)](#) and [Biocultural \(BC\)](#) Labels and Notices as mechanisms within the [Local Contexts](#) system that help ensure Indigenous data is FAIR. Other domain-specific efforts, such as the [Canadian Integrated Ocean Observing System](#) (CIOOS) and [Ocean Networks Canada](#) (ONC), serve as exemplars of robust community-led approaches to the adoption of best practices. Finally, among the NDSs deemed necessary were tools to further support and enable quality FAIR data collection at source, a researcher dashboard and communication tool to facilitate access to RDM resources, as well as coordinated semantic and vocabulary services.

Services

According to the adapted 6-part model, services are defined as *generic and discipline-specific services directly supporting researchers and institutions, as well as funder, publisher and institutional policy*. Participants expressed interest in locally delivered services by professionalized groups, supported financially and properly resourced nationally and linked internationally. These services could also potentially be supported by national implementation and technical advisory teams, which were deemed a priority for the next 6 to 12 months. Especially in light of NDRIO progress, participants encouraged continued collaboration between all RDM stakeholders to support enhanced and open access to coordinated services, best practices, and training. Establishing national training as scaffolding for local skills development was deemed ideal.

An identified priority for the next 6 months was the creation, publication, and maintenance of a compendium or knowledge base of the RDM ecosystem, possibly in the form of a centralized searchable national registry or resource portal. This would also form an integral part of a potential researcher dashboard service. Over the next 2 to 5 years, participants also wanted to see further integration of services across the RDM ecosystem as well as across the three NDRIO pillars (research software, advanced research computing, and data management). Development of new services and ongoing review of RDM resources, supports, and services are also long-term priorities.

A variety of existing services were highlighted by participants as well on their way toward these goals. A suggested priority for the next 2 years was a knowledge base of data management plans (DMPs), which the [Portage Data Management Plan Expert Group](#) (DMPEG) is working to provide by populating the [DMP Assistant](#) tool with discipline-specific DMP templates. The [Data Liberation Initiative](#) (DLI) and [Open Science Framework](#) (OSF) are representative of existing platforms providing researchers with access to data and support in their own work. DLI provides an exemplar network of expertise, while OSF is a current exemplar for a data sharing platform that models the basic features of open science practices. Long-term data preservation services and additional training opportunities, particularly for smaller institutions, were identified as emerging services, while implementation teams and consulting services were tapped as needed services moving forward.

Access & Interface

According to the adapted 6-part model, access and interface are defined as *human and machine interfaces that make it easy to deposit and access data, including robust support for privacy and security where appropriate*. Above all, participants indicated that incentivizing best practices for researchers was an ideal approach to ensure standardized deposit processes. An API, or collection of linked APIs with appropriate flexibility and data discovery, inventory, and exploration tools, would further ease data access and deposit processes, as would common, user-focused interfaces. A robust, centralized identity management system would also enhance security and interoperability. Participants indicated that ethics should be considered in relation

to data management, planning, and operations, citing the [Association of Internet Researchers' \(AOIR\) Ethics Working Committee](#) as a valuable resource for guidance.

Participants highlighted a variety of existing NDSs already providing access and support for deposit processes. [Scholars Portal Dataverse](#) was offered as an exemplar of flexible open source repository software, while the [Federated Research Data Repository](#) (FRDR) works to answer participants' calls for a national federated platform for data discovery. The [Canadian Research Data Centre Network](#) (CRDCN) was cited as an exemplar of a secure source of access to confidential and sensitive data. Among emerging access and interface services were a number of domain-specific resources, including the [Canadian Open Neuroscience Platform](#) (CONP) and the [CanDIG](#) genomics framework as exemplar national specialized repositories. Finally, participants indicated that RDM for sensitive data, and repositories specifically designed for sensitive data, were needed moving forward. Long-term preservation and sustained storage, with scalability for large datasets, were also highlighted as services that should be further invested in, with the suggestion of establishing a national Canadian data preservation infrastructure.

Rules

According to the adapted 6-part model, rules are defined as *policy and process scaffolding that facilitates participation by all actors in the research ecosystem, supports jurisdictional contexts, and engenders trust*. Participants indicated that a Canadian common baseline for standards and policies should be a goal of RDM entities moving forward. Transparency from NDRIO and all related organizations in policy and decision-making for key service parameters was also deemed essential to continue building credibility and trust among stakeholders. Along with incentivization of data deposit practices, participants also felt compliance with clear rules should be similarly incentivized in a way which would be measurable, with a particular focus on DMP requirements. These rules should also be agnostic of funders and include the use of PIDs in order to further drive discovery and allow measurement of researcher efforts.

Establishment of sustainable long-term funding was cited frequently across all three breakout groups as essential for the success of NDRIO and NDSs in general. Some tangible recommendations for achieving sustainable funding included securing extensions on federal funding for staff transition, developing detailed budget and income streams that reflect continuity of existing services, adding generous additional budget lines for RDM in funding applications, and creation of funding programs to support people, software, and hardware. The FAIR principles as applied to data, software, and services, are increasingly integrated into funder requirements, and as such, FAIR certification could be another viable option for further reinforcing sustainable funding. [RDA's FAIR Data Maturity Model Working Group](#) has developed a common set of core criteria to assess the implementation level of the FAIR data principles, providing an exemplar of FAIR metrics. Some data repositories (e.g. [DataONE](#)) provide a built-in and automated assessment of the FAIRness of individual data objects and collections.

Particularly in terms of NDRIO, participants indicated that over the next 2 years, policies, procedures, data standards and protocols should be established based on existing services and resources. The structure of national-level services integrated with the international community, and accompanied by outreach to local and domain-specific entities also extended to discussion of policy and process scaffolding, and participants deemed a researcher-driven, ground-up approach to be the most ideal. The [First Nations Principles of Ownership, Control, Access, and Possession](#) (OCAP) were cited as an existing set of rules that ensure appropriate collaboration and governance of First Nations research data and research practices. The [Global Indigenous Data Alliance](#) (GIDA) and the [CARE Principles of Indigenous Data Governance](#) which prioritize Collective benefit, Authority to control, Responsibility and Ethics also provide international guidance on Indigenous data stewardship. Participants also highlighted a data ethics advisory service as well as funding for hiring RDM HQP for smaller institutions as needed services in the future.

Governance

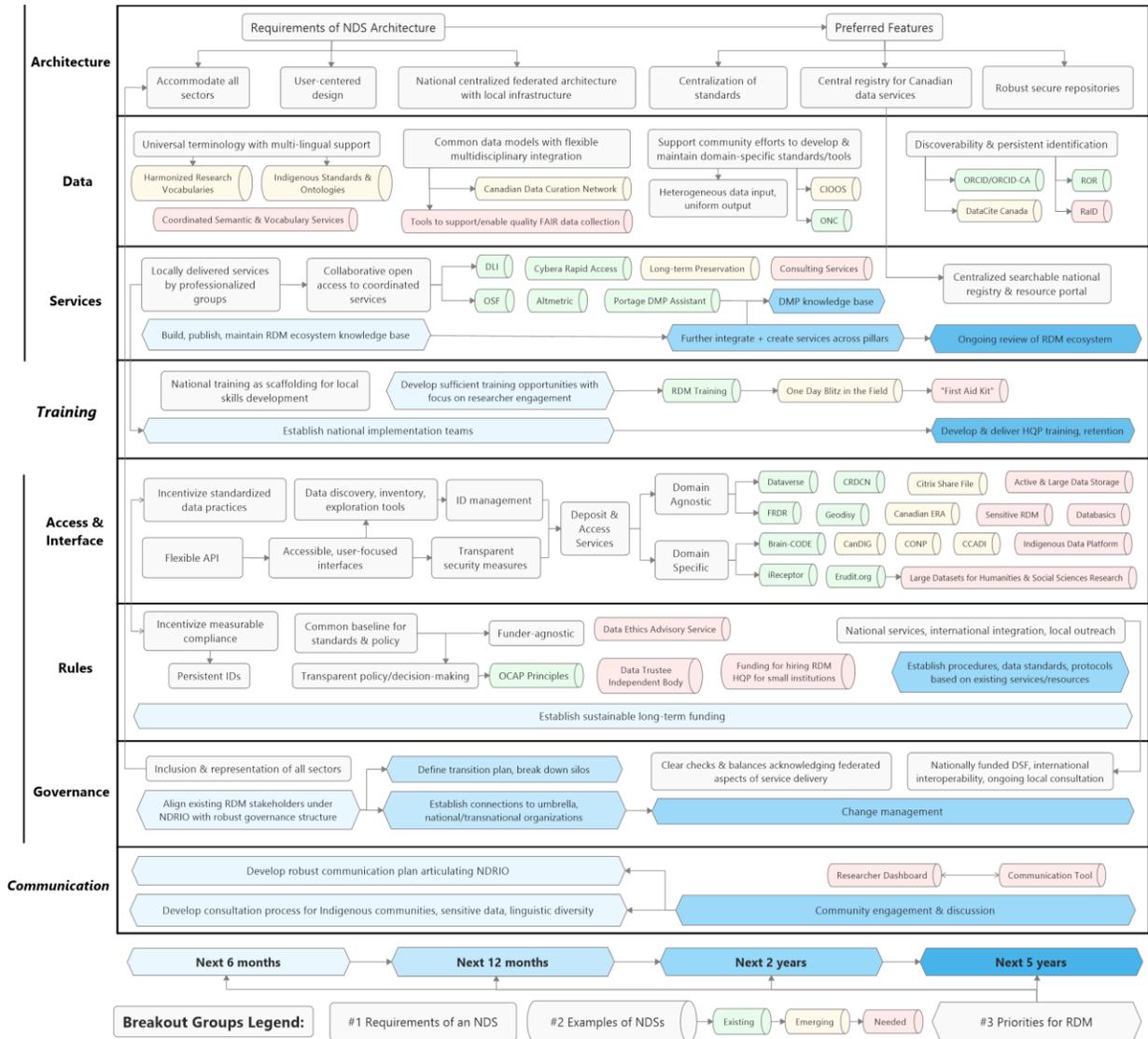
Finally, according to the adapted 6-part model, governance is defined as *the framework that ensures representation by all actors in the development and sustainability of Canada's digital research infrastructure and ecosystem*. Most importantly, participants wanted to see active engagement, inclusion, and representation of all sectors and domains in RDM governance bodies, with special consideration of under-represented voices in the RDM landscape. Again, echoing a similar structure, participants envisioned a nationally funded data services framework with international interoperability and ongoing regional/local consultation, and indicated that connections to umbrella organizations as well as national and transnational organizations should be established over the next 12 months. A system of clear checks and balances that acknowledge the federated aspects of service delivery at all levels is important to advance transparency, credibility, and trust.

In the next 6 months, participants envisioned alignment of existing organizations and stakeholders in the RDM ecosystem under NDRIO to establish a robust governance structure, followed by a defined transition plan to continue this alignment and break down silos in the next 12 months. Beyond initial alignment and transition, breakout groups frequently echoed the need for effective change management, particularly throughout the next 2 to 5 years.

Visualization

The image below provides a [visual summary](#) of the various suggestions that emerged from the NDSF Summit 2020 breakout sessions.

NDSF Summit 2020 Breakout Summary



List of National Data Services

The following existing and emerging NDSs were specifically highlighted in the summary text above, and in the breakout sessions:

1. [ORCID-CA](#)
2. [DataCite Canada Consortium](#)
3. [Research Organization Registry](#) (ROR)
4. [Altmetric](#)
5. [Research Activity ID](#) (RaID)
6. [Canadian Integrated Ocean Observing System](#) (CIOOS)
7. [Ocean Networks Canada](#) (ONC)
8. [Portage DMP Assistant](#)
9. [Data Liberation Initiative](#) (DLI)
10. [Open Science Framework](#) (OSF)
11. [Scholars Portal Dataverse](#)
12. [Federated Research Data Repository](#) (FRDR) with [Geodisy](#) as geospatial discovery service
13. [Canadian Research Data Centre Network](#) (CRDCN)
14. [Canadian Open Neuroscience Platform](#) (CONP)
15. [CanDIG](#)
16. [RDA's FAIR Data Maturity Model Working Group](#)
17. [DataONE](#)
18. [First Nations Principles of Ownership, Control, Access, and Possession](#) (OCAP)
19. [CARE Principles](#) of Indigenous Data Governance

The following list of existing, emerging, and needed NDSs are additional services mentioned in the breakouts:

1. [Cybera Rapid Access Cloud](#)
2. [Erudit](#)
3. [Brain-CODE](#)
4. [iReceptor Gateway and iReceptor Public Archive](#)
5. [FAIRsharing](#)
6. [Citrix Share File](#)
7. First Nations, Métis and Inuit [Ontologies](#)
8. [Canadian Open Neuroscience Platform](#) (CONP)
9. [Canadian Consortium for Arctic Data Interoperability](#) (CCADI)
10. [Re3data](#) - Registry of Research Data Repositories
11. [COUNTER](#) Code of Practice
12. [Make Data Count Initiative](#)
13. Canadian version of [Excellence in Research for Australia](#) (ERA)
14. Databasics: Database-tuned dataset creation VM/portal
15. Indigenous Data Platform
16. First Aid Kit (national RDM training framework)

Recommendations

The following Recommendations have been extracted from the discussion at the 2020 Summit and are listed by broad stakeholder group. These recommendations are ultimately intended to facilitate researcher adoption of best practices in data management throughout the research lifecycle, so while they are addressed primarily at the stakeholder community that supports researchers, the goal with all is to see benefit to researchers. The terms in parentheses at the end of recommendations either refer back to one of the themes from the EOSC model (Architecture, Data, Services, Access & Interface, Rules, Governance), which was a lens for much of the discussion at the Summit, or to an overarching theme which emerged from the breakout groups (Communication, Training). Timelines are specified when they could be extracted from the breakout discussions.

All Stakeholders

1. Continually communicate the developments of the RDM ecosystem to researchers and the general public, ideally using a communication tool that facilitates updates on activities, as well as the ability of stakeholders to comment. (Communication)
 - a. Consider a communication approach that integrates the various organizational roadmaps, along with the [Kanata Declaration](#), into a single publicly accessible reporting/communication tool. (Communication)
2. Develop and deliver a national training program that serves as scaffolding for local skills development, and addresses the needs of service providers, and researchers. (Training)
 - a. Ensure a strong intersection with international training frameworks and resources. (Training)
3. Accommodate all sectors and domains in terms of national architecture and diverse inclusive representation in governance. (Governance)
 - a. Use upcoming NDSF Summits as opportunities to engage the broader community in describing the architectural details of the NDSF. (Communication)
 - b. Ensure a strong intersection with international DRI architectures, both to increase interoperability, but also to facilitate benchmarking. (Services)
4. Through consultation, develop more services focused on Indigenous data, including platforms, repositories, standards, and vocabularies. (Services)
 - a. Promote adoption of [Traditional Knowledge \(TK\)](#) and [Biocultural \(BC\)](#) Labels and Notices. (Data)
5. Use and develop terminology and controlled vocabularies with multilingual support to improve access and interoperability (Data).
 - a. Promote use of the [CASRAI/CODATA RDM Glossary](#), and add missing terms as needed. (Services)
 - b. Provide consistent support for both English and French language use of Canadian NDSs, and ideally First Nations, Métis, and Inuit languages as well. (Data)
6. Develop long-term data preservation options, potentially in the form of a national data preservation infrastructure. (Services)

- a. Expand on the efforts of the [Portage Preservation Expert Group](#) (PEG), and ensure an intersection with preservation practices in specific domains. (Communication)
- b. Ensure a strong intersection with international preservation networks, standards, and platforms. (Services)
7. Establish funding for hiring RDM HQP, particularly for smaller institutions. (Rules)

Researchers

1. Engage with available training resources and events to ensure currency with best practices in RDM. (Training)
2. Engage with and reach out to Canadian service providers to articulate current and future needs. (Communication)
3. Include funds in all funding applications to facilitate preparation and provision of FAIR as appropriate. (Rules)
4. Ensure the use of international standards when describing datasets, including descriptive, administrative, provenance, ownership metadata profiles. (Data)
5. Researchers involved with the development of DRI ensure the implementation of international best practices in software development, metadata, and other appropriate standards. (Architecture)
6. Ensure the use of appropriate Indigenous labels and contexts for datasets that involve Indigenous communities. (Rules)
7. Ensure that data and associated research components are deposited in repositories that can provide long-term storage and preservation. (Data)

Research Funders

1. Incentivize standardized data deposit practices and data management best practices. (Rules)
2. Further incentivize measurable compliance to appropriate data stewardship activities (e.g. DMPs, data deposit, study pre-registration). (Rules)
3. Work with other funding agencies to ensure a sustainable approach to funding the development and maintenance of DRI. (Governance)

Universities and Research Centres

1. Establish a data ethics advisory service. (Rules)
2. Develop and promote available policy and support for researchers to make data FAIR. (Communication)
3. Facilitate the engagement of researchers and institutional research support service HQP in national and international best practices for RDM. (Rules)

Science-based Government Departments and Agencies (SBDAs)

1. Establish a data ethics advisory service. (Rules)
2. Ensure participation of SBDA HQP in national and international RDM organizations and committees. (Governance)
3. Ensure coordination and standardization of DRI and policy across government. (Rules)
4. Ensure DRI developed in the government context are interoperable with complimentary initiatives in the higher education and other sectors. (Architecture)

Repositories and Publishers

1. Aim to provide universal discoverability while still providing sufficient specificity for individual domains. (Access & Interface)
2. Develop a Canadian data preservation infrastructure with sustained storage scalable for large datasets. (Services)
3. Develop domain-specific standards and tools that would allow heterogeneous data input and uniform data output (Data)
4. Develop repositories and data standards specifically for sensitive data (Access & Interface)

RDC, Portage, and NDRIO

1. Develop a robust and transparent communication plan to clearly articulate the function, structure, and value of NDRIO. (Communication)
2. Determine how partners in the RDM ecosystem fit together at all levels - local, regional, national, and international. (Governance)
3. Align existing RDM organizations and stakeholders under NDRIO and establish a robust governance structure over the next 6 months (Governance)
4. Develop a clearly defined transition plan to further align NDRIO partners and integrate the three service pillars (research software, advanced research computing, and data management) over the next 12 months (Governance)
5. Develop a national registry or knowledge base of the entire national RDM ecosystem - organizations, services, tools, stakeholders - as a searchable resource portal. (Data)
6. Develop a centralized federated architecture with local infrastructure and data hosting, made accessible through an API defined by common standards (Architecture)
7. Support locally delivered services by professionalized groups, supported financially and properly resourced by a national framework and linked internationally (Services).
8. Provide national implementation and technical advisory teams (Services)
9. Establish a Canadian common baseline for standards and policies (Rules)
10. Establish NDRIO policies, procedures, data standards and protocols based on existing services and resources over the next 2 years (Rules)
11. Establish connections to umbrella, national, and transnational organizations over the next 12 months (Governance)
12. Consider change management throughout the next 2- 5 years (Governance)

Glossary of Acronyms

Acronym	Definition
API	Application Programming Interface
BC	Biocultural
CCADI	Canadian Consortium for Arctic Data Interoperability
CDCN	Canadian Data Curation Network
CIOOS	Canadian Integrated Ocean Observing System
CONP	Canadian Open Neuroscience Platform
CRDCN	Canadian Research Data Centre Network
DLI	Data Liberation Initiative
DMP	Data Management Plan
DMPEG	(the Portage Network) Data Management Plan Expert Group
DOI	Digital Object Identifier
EOSC	European Open Science Cloud
FAIR	Findable, Accessible, Interoperable, Reusable
FRDR	Federated Research Data Repository
HQP	Highly Qualified Personnel
NDRIO	New Digital Research Infrastructure Organization
NDS	National Data Services
NSDF	National Data Services Framework
OCAP	(First Nations Principles of) Ownership, Control, Access, and Possession
ONC	Ocean Networks Canada (Oceans 2.0)
ORCID	Open Researcher and Contributor Identifier
OSF	Open Science Framework
PEG	(the Portage Network) Preservation Expert Group
PID	Persistent Identifier
RDA	Research Data Alliance
RDC	Research Data Canada
RDM	Research Data Management
ROR	Research Organization Registry
TK	Traditional Knowledge