Interface Matters

a white paper on Canada's future digital research infrastructure needs

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This white paper focuses on the importance of human and technical interfaces to the ability of researchers to make effective and efficient use of NDRIO's platforms and services. NDRIO's interfaces will be a constitutive factor in its ability to support advanced research computing with an expanded mandate and a commitment to equity, diversity, and inclusion. The views expressed here emerge from running the Canadian Writing Research Collaboratory on national DRI resources and from insights gained from colleagues, including during terms as President of the Canadian Society for Digital Humanities, of the apparently banal but nevertheless significant obstacles that interfaces can pose to using DRI.

Infrastructures are not neutral; they often reinforce existing structures of power, privilege, and discrimination. In operationalizing public policy through "technology as practice," the interfaces through which users interact with NDRIO's technologies will shape the future of Canada's research community. Command-line tools dominate in many traditional DRI contexts. However, underestimating the value of carefully designed graphical user interfaces (GUIs) to the new and expanded national DRI system would be a grave error. The attempt to create cultural and organizational change is a design problem: one important study found that infrastructure is "fundamentally relational" and "there are no genuine universals in the design of large-scale information technology."

Designing effective interfaces between researchers and the system as a whole, represented by both people and machines, will be crucial to NDRIO's success.

NDRIO thus faces a huge challenge of meaningful design, which must be embraced by an organization from the start. A commitment to equity, diversity, and inclusion—as well as to serving the entire disciplinary and methodological spectrum of digital research infrastructure needs in Canada—demands extensive investment in research-centred interface design focusing on the means by which people will interact with NDRIO people and systems.

The overall need, therefore, is for early, significant, and sustained investment in user-experience design for NDRIO's human and system interfaces.

The following outlines some areas in which interfaces play a crucial role and they offer some specific suggestions from the perspective of members of the CWRC team. This is necessarily partial; a user-centred design process will surface more needs and different perspectives.

Outreach and communications

NDRIO will have to work hard to reach non-STEM fields, where there is a surprising lack of awareness of national DRI resources. For example, the IT manager at one of Canada's larger universities, who regularly advises researchers on available resources, was completely unaware of DRI resources until pulled into a discussion of a cyberinfrastructure proposal.

Libraries, now that they are increasingly involved in research data management consulting, in addition to research computing units within institutions where they exist, should be engaged in promoting awareness on campuses, supplementing the work of research computing units, where they exist, to reach a wider range of disciplines. Creating institutional ambassadors, pairing them with outreach staff from within NDRIO, and equipping those ambassadors with resources for presentations and consultations would help address this challenge.

Communication between infrastructure team members and researchers

NDRIO needs to develop agile and adaptable strategies for ensuring accurate and informed communication tracking and threading.

A generic email-based ticketing system is inadequate when it comes to providing the right information to the right person (those with capability to act on a communication) without spamming those who don't need the information when project roles vary significantly. It should be possible to make the flow of communication from the infrastructure team to the researcher team configurable (and easily adjustable on either side) within the interface to the user database, so that communication flow can be customized for each research project's specific needs. For example, a non-technical research director could choose to include the project manager or technical lead on all communication from the infrastructure team, so that project members can take faster action without relying on the project director as a go-between.

Tracking communications and actions in a centralized fashion is essential, so that when communications or actions are handled by multiple NDRIO team members, they are visible to all in order to avoid redundancy and confusion. So is establishing consistent naming conventions to be used across different communications contexts, so that, for instance, systems, servers, and resource allocations are referred to with the same identifier. This will significantly reduce confusion for those less versed in using the infrastructure, as will avoiding the use of acronyms without accompanying explanation, and reviewing centralized system interfaces and automated messaging for clarity of language.

Ensuring timely responses to problems is very important. Delays in response to support requests compound confusion about who is responsible. Consider models for addressing this problem, such as having responsibility flagged in a transparent issue-tracking system.

Summary:

- Improve institutional interfaces by actively engaging ambassadors from libraries.
- Establish clear avenues for communication, both on which research project team member(s) to include in particular communications, and who is acting on open tickets.
- Ensure multiple team members interacting with the same researcher/group are fully informed of prior communications or actions.
- Promote consistent nomenclature and clear language use.
- Establish targets for response times and ensure sufficient staffing levels to meet them.

Administrative interfaces

NDRIO needs to provide a single, accessible point of contact with its administrative platform for managing user accounts, resource allocations, and documentation. This is not to say that all systems need to be integrated, but do not underestimate the impact upon researchers of the lack of a usable, comprehensive, centralized interface. There should be a single, well-designed point from which users can start in order to discover and access NDRIO resources.

Providing a common interface for a federated system will constitute a major challenge. Nevertheless, a common system for measuring key performance indicators (KPIs) is already being developed, and it is having a strengthening impact on the DRI system. A common interface should be given equal priority.

This single administrative interface should cover or link to as many NDRIO administrative functions as possible, such as:

- ➢ Account creation and management
- ➢ Sponsored account management, including the ability to manage user roles in relation to specific allocations/projects
- ➢ Allocations, including the computational systems to which allocations are assigned
- ➢ System monitoring and statistics from across all systems
- ➢ Transparent usage reporting from across the system, mirroring what NDRIO staff see
- ➢ Reporting and other administration for all allocations, including user delegation/sharing
- ➢ Requests for changes such as shifting resources
- ➢ Communications record
- ➢ Support requests/issue tracking

Although a single system may be neither desirable or achievable, a coordinated user experience beginning from a main interface is. Links to separate systems, for instance one for tracking communications and support requests, should be made available through the main interface. Even if separate dashboards need to be maintained for different systems, the main NDRIO interface should clearly link to all systems allocated to or used by the researcher or team, and those systems should funnel main usage data back to a single NDRIO dashboard.

In working to align Canada's digital infrastructure system with research funding cycles, NDRIO could take on a leadership role with respect to the application and reporting interfaces of the granting councils, which sorely need updating. For instance, NDRIO could enable the Common CV to live up to its name. A CV that could be used for any Canadian federal grant application, was flexible enough to feed into institutional processes for tenure or promotion, and could be pulled from for reporting purposes to multiple funders, would save considerable researcher time. If it were built to use persistent identifiers for researchers, publications, datasets, and grants, the CV would also provide a foundation for making it easier to find, access, reuse, and promote Canadian research and research data worldwide.

As a funder of and collaborator with other components of the Canadian research funding system, NDRIO should work to ensure accountability for the use of public funds without undue overhead, which is a significant burden on individuals and institutions. The administrative overhead associated with some components of the current system are so high that if it were replicated by NDRIO some researchers and organizations would be deterred from participating in NDRIO initiatives, resulting in reduced innovation, synergy, and alignment of efforts.

Summary:

- Ensure the main NDRIO interface provides access to all of the functionality and information users need in order to access, manage, and report on their use of DRI.
- In aligning with other federal funding administration, rationaliize and improve interfaces for the system as a whole to reduce redundant activities across the system.
- Conserve researcher and institutional time by producing efficient systems for DRI funding administration and accountability.

Support, training, and scaffolding interfaces

Pan-Canadian, pan-disciplinary support

Given a funding model that situates responsibility for most support with the provinces, NDRIO needs to devise a model for ensuring that research computing support is available equitably and in appropriate forms. This will be particularly important for tools and methods in non-traditional fields, for which there will not be support available in every region. Various models, including that of Europe's DARIAH infrastructure, should be considered in working towards a flexible model for recognizing contributions towards a federated system. The complexity of the system will necessitate equally creative support interfaces—ones that combine human and technical resources from different locations—to ensure equity of support. The model needs to provide incentives to support services, initiatives, and platforms that span multiple regions.

Communities of practice

As John Seely Brown and Paul Duguid show, Communities of Practice are at least as important to technology uptake as technical affordances produced by "tunnel design." While some research domains have strong, existing internal Communities of Practice, NDRIO needs to ensure that underrepresented groups in particular have access to support, training, and interactions with other users that will allow them to use NDRIO resources effectively. NDRIO should encourage the process of scaffolding, whereby users move towards better understanding and adoption of best practices in their use of the infrastructure. Scaffolding for under-served research areas can be enabled through accessible platforms that guide users in best practices, support more sophisticated operations through GUIs, and provide the foundation for Communities of Practice that will assist in further scaffolding.

For more technical users and project staff, NDRIO could promote Communities of Practice by forming user groups for specific components of the NDRIO infrastructure, which could include members of the NDRIO team for that component. In addition to fostering group/peer support as a complement to individual support, this would have the added benefit of looping in users from beyond the Researcher Council who could also share perspectives and concerns with NDRIO. Bringing together projects using the Cloud environment might identify projects using similar technologies. At a basic level, users might share experiences and knowledge; at a higher level they might create a shared instance to lower maintenance costs and build a more operationally resilient deployment without detracting from research goals. A piece of infrastructure shared amongst projects potentially helps each project focus more time/money on research goals and helps reduce the number of VMs and potential areas of security risk. Possibilities include relational databases (e.g., PostgreSQL), observability tooling (e.g., ELK), and Kubernetes.

NDRIO should explore platforms for supporting Communities of Practice within the DRI ecosystem, through which community members could ask questions, provide peer support, and look up possible solutions before reaching out for one-on-one support from NDRIO staff. It might be possible to integrate such a system with a documentation system that could take community-contributed enhancements and corrections. The need to support novices, non-traditional domains, and marginalized groups should be kept in mind, and models such as Fem/Tech/Net should be evaluated alongside more mainstream tech sites such as StackOverflow, which disadvantages women.

Scaffolding best practices

A significant challenge to a robust DRI system in Canada is the fact that all but the largest research projects or communities lack the resources to hire full-time trained systems

administrators, which has serious implications for quality assurance and maintenance processes, as well as for security. While NDRIO cannot support all tools and platforms, there would be significant gains in providing training and support for some key ones.

As infrastructure, especially application stacks, becomes increasingly complicated and thus harder to deploy, maintain, and secure over time, NDRIO should consider creating Platform as a Service (PaaS) in areas that would help decrease the effort expended by research teams and enable them to focus on the research goals. Possibilities for broadly useful PaaS include:

1. A centralized Kubernetes PaaS offering. Containers offer an infrastructure-as-code solution to aid deployment in a dev/test/production environment and an opportunity to run security scans against the images backing the containers for more in-depth security than is currently available to Compute Canada and OpenStack VMs. A centralized monitoring/observability service may also offer opportunities to find problems in both security and performance.
2. Systems that support the combination of development, security, and operations (DevSecOps) to improve development practices and shift security considerations to earlier in the research software development lifecycle so that problems are detected and dealt with earlier. This could be supported through pipelines connected to a code repository to run such things as container scanning for security vulnerabilities; dependency scanning for third-party libraries/modules with security updates; dynamic application security testing to detect vulnerabilities on a running application, and static application security testing to analyze code to detect vulnerabilities. Pipelines could also support testing interfaces for compliance with accessibility legislation as well as behavior-driven tests (e.g., unit tests).
3. Sustainability and archiving solutions. The ability to maintain a complex application stack often exceeds the capacity of a research team in the long term, especially if specialized staff cannot be retained, yet continued access to the data in combination with software may be desirable. In such cases, NDRIO RDM staff might offer PaaS and guidance implementing a minimal computing environment, virtual archival machine, or container-based archiving solution.

Summary:

- Ensure support interfaces are equitable regardless of region or specialization.
- Foster scaffolding in under-served research areas through accessible platforms.
- Provide a platform for Communities of Practice to serve infrastructure subgroups
- Extend NDRIO support interfaces to include Platform-as-a-Service, particularly where it would improve efficiency, software quality, and security in the system as a whole.

Iterative evaluation and revision

As Winner observed, infrastructure is at its most malleable early in its implementation. For that reason, ongoing assessment, engagement with researchers, and revision to the NDRIO interfaces must be a priority. NDRIO should use regular Communities of Practice and Birds of a Feather sessions, in addition to surveys, to draw out deeper insight on user experience and project upcoming needs. Since demand will always outstrip NDRIO resources, this feedback could be used to build bridges between projects with similar infrastructure needs, and to encourage projects to collaborate on the deployment or maintenance of shared infrastructure.

Summary:

- Continually iterate NDRIO interfaces, based on feedback from users and evaluation against NDRIO's core values, to determine overall priorities, possibilities for collaboration, and how interfaces could be improved to meet evolving needs.