2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
Paper ID #38906

Research Data Sharing in Engineering: A Report on Faculty Practices and Preferences Prior to the Tri-Agency Policy

Ms. Sarah Parker, University of British Columbia, Vancouver

Sarah Parker is an engineering librarian at the University of British Columbia where she also received her MLIS in 2014. She regularly promotes and contributes to open scholarship activities at UBC and incorporates her interest in open science and using open resources into her teaching. In addition to her liaison role, she aids in graduate student programming for UBC's Research Commons and co-teaches the Science and Technology Information Sources and Services course at the School of Information in the Faculty of Arts.

Research Data Sharing in Engineering: A Report on Faculty Practices and Preferences Prior to the Tri-Agency Policy

Abstract

The Tri-Agency Council of Canada that includes the Natural Sciences and Engineering Research Council of Canada (NSERC) is implementing its Research Data Management (RDM) Policy in the Spring of 2023. The policy requires Canadian post-secondary institutions to develop an Institutional RDM Strategy to support and guide researchers funded by one or more of the Tri-Agencies. Researchers will be required to provide a Data Management Plan (DMP) and deposit their research data into a repository at the time of publication to fulfill funding obligations. This paper describes the survey results conducted at a U15 research institution in Canada asking engineering faculty about their research data sharing practices and preferences. The purpose of the survey was to answer the following questions: 1. How well prepared are engineering researchers for data deposit, 2. Are engineering researchers willing to share their data, and 3. What barriers exist for sharing engineering data? Results demonstrate knowledge of and acceptance of open access (OA) practices but when it comes to data, engineering researchers are more reluctant and less prepared to share their data widely and may need guidance on RDM best practices. Subject librarians can prepare to aid faculty and educate students by gaining an understanding of engineering data management and sharing behaviors. Faculty may benefit from RDM support through all stages of the data life cycle and students may benefit from RDM literacy introduced into their curriculum. The described survey results in this paper aim to help the subject librarian identify where they might best offer support for faculty and students.

Introduction

Disciplinary norms for data sharing vary widely. Some disciplines in the sciences have a long history of making their data available for reuse and to demonstrate reproducibility and replicability [1], [2]. For engineering, open science practices that include data sharing through data deposit are less common [3], and researchers may be reluctant, with a preference to share data only when requested [4], [5] or only with peers [6].

How well prepared are engineering faculty to deposit data in a repository to fulfill funding or publication requirements? In 2021, Canada's federal granting Tri-Agency Council released its draft Research Data Management Policy, mandating that by Spring 2023 some funded researchers will be expected to complete data management plans (DMP) [7]. All funded researchers will be required to deposit their data into a repository with the expectation that researchers "provide appropriate access to the data where ethical, cultural, legal and commercial requirements allow, and in accordance with the FAIR principles and the standards of their disciplines [7]." The FAIR principles encourage data to be findable, accessible, interoperable, and reusable.

With consideration to the policy guidelines and from the perspective of a subject liaison librarian supporting engineering faculty, the author set out to understand the data practices of engineering researchers at the University of British Columbia (UBC) and developed a survey to answer: 1. How well prepared are engineering researchers for data deposit, 2. Are engineering researchers willing to share their data, and 3. What barriers exist for sharing engineering data? Even though data sharing is explicitly not required in the Tri-Agency's policy, it is encouraged and many journal policies where UBC engineering researchers publish encourage or require data sharing when possible or in the very least require a data availability statement.

This study looks at data sharing in a Canadian context where engineering research at post-secondary institutions is predominantly funded by NSERC (Natural Sciences and Engineering Research Council of Canada). To date at the writing of this paper, there has been no focus on the data sharing practices and preferences of engineering researchers in Canada. In 2015 and in response to an earlier draft of the Tri-Agency's policy, UBC Library conducted an internal survey to determine what research data management services would be needed to support faculty. The [8] survey was part of an internal scan that would help plan research data services for the Library. Results included information from both the sciences and engineering with 20% of the responses from engineering. Since that 2015 survey the research data landscape has grown and data sharing has become more prevalent in all subject areas. UBC established and built support for research data management services and further developed its infrastructure that includes a data repository, Borealis, a bilingual Canadian Dataverse Repository that is supported by academic institutions across Canada. With more awareness of data services and repositories available, this study set out to explore the current practices in engineering. For the subject librarian, understanding the data sharing behaviour of their faculty and students can help them prepare to assist as policies and guidelines evolve.

Background and Literature Review

The genesis of this study came from questioning whether engineering faculty may find open science participation a challenge given that they may be filing for a patent or work with an industry partner with intellectual property rights concerns. Given that more journals and funding agencies require some form of data discovery whether it be open or not, researchers will be negotiating open science practices more and more. Unlike some disciplines such as ecology and genomics where data sharing is necessary to move the field of research forward, similar practices in engineering have not been widely adopted. Furthermore, disciplines that have a data sharing history have further developed the infrastructure needed to support open science practices [3]. For the purposes of this paper open science is used as broadly defined by [9]:

> "Open science, or more broadly open research, describes the activity of performing scientific research in a manner that makes products and findings accessible to anyone. This includes sharing data openly (open data), publicly releasing the source code for research software (open-source software), and making the written products of research openly accessible (open access)."

Adoption of open science practices in engineering is evident with articles that are published open access. The number of open access publications has grown as grant agencies require articles to be made freely available at the time of publication or within a specified amount of time after publication. In Canada, NSERC requires researchers deposit an article into a repository or publish open access within 12 months of peer review publication [10]. This ensures that publicly funded research is made available to anyone who would like access. A similar approach with data is being taken by the Tri-Agency Council:

> Grant recipients are required to deposit into a digital repository all digital research data, metadata and code that directly support the research conclusions in journal publications and pre-prints that arise from agency-supported research. Determining what counts as relevant research data, and which data should be preserved, is often highly contextual and should be guided by disciplinary norms. [7]

Data deposit is a step towards adoption of more open science practices. The policy indicates that open data is preferable, if possible, but not required. Additionally, researchers are expected to follow the FAIR principles where FAIR data is as open as possible and as restricted as necessary. In sum, the policy instructs researchers to follow "disciplinary norms," [7] but what are the disciplinary norms in engineering?

A review of the data sharing behaviour in engineering can provide some insight into disciplinary norms. This can help the subject librarian identify what areas may need additional support. Even though a broader library-wide approach to RDM services is more manageable and scalable, for the subject librarian understanding the information behaviour of the field inclusive of data sharing behaviour can help inform what resources may be required, what aspects can become part of instruction, and where the most support is needed.

Evidence in the literature reporting on surveys and focus group interviews demonstrate that engineers do not readily share their data in practice, preferring to share at the time of publication. Even then they may only do so if the journal provides data storage or if it requires data be supplied with the article [6], [11], [12]. Reasons for not sharing are linked to incentives or lack thereof more than anything else. It is relevant to note that data sharing may occur differently depending on the type of data and whether it is raw or processed. Regardless of the type, the literature illustrates that engineering researchers are more likely to make data available as supplementary material published with a journal article and they are not depositing data in repositories with consideration to long term preservation [5], [6]. Furthermore, data sharing is more likely to occur with immediate collaborators within a research team, or with industry partners, or simply by request [4], [5], [6], [13], [14].

A lack of incentives both internal and external does not encourage engineers to make any additional effort to disseminate their data. In [2] they suggest "industry connections and [the] strongly applied nature of engineering have hindered adoption of open practices [2, p. 7]." This is layered with a pre-existing "cultural inertia" in the field of engineering [2, p. 6]. To change this norm, [2] suggest that the work belongs to the institutions who could adopt open policies that could rectify how research successes are measured and how promotion and tenure is awarded [2]. Similarly, [13] also cite the institutional rewards system as a barrier. Incentivizing data deposit and the "adoption of open data principles are poorly linked with institutional systems of professional esteem, reward and promotion [13, p. 578].” Lack of standards for describing and documenting data is also viewed as a limiter to sharing as researchers expressed concern over how that data will be interpreted without standardization [13]. Like [2], [13] found industry partnerships to be a barrier where non-disclosure agreements are common putting the partner in control of how information is disseminated. A final barrier not seen in other studies was a concern over a “loss of control and autonomy” over their data [13, p. 585].

Lack of institutional incentives might hinder data sharing in practice, but the benefits of shared data and open science are well-known amongst researchers, and it is well documented in the literature even if the evidence demonstrates that engineers may be more closed in practice. From the papers that focused on open data and research data practices across multiple disciplines as well as within engineering, the common benefits of data sharing were noted to include that it provides access to publicly funded research, validates research, demonstrates transparency, increases reproducibility, and reduces duplication [3], [13], [14], [15] [16]. Familiarity with the multitude of benefits is not enough to spur on adopting open science practices. Ultimately, the challenges and barriers found in the research literature such as the time and effort required to prepare data for deposit outweigh the benefits. This coupled with lack of institutional incentives slows down access [3], [4], [17].

The aforementioned studies look from the outside in, but [16] write from the chemical engineering perspective in Canada and suggest that not only do the barriers mentioned above slow down access, but such barriers may actually be slowing progress in the field. They too find a willingness to share within the engineering field given the right conditions. Similar to what other studies have found, they cite the academic system that rewards publications over all else to be a central issue that slows progress towards adoption of open science practices. From their Canadian perspective they point to the Tri-Agency’s policies that have arrived late when compared to other countries and suggest that the impact of late policy has slowed the open science movement in Canada [16]. Even though they recognize that industry partnerships may create some tension in how open information can be shared, they produce examples of engineering/industry partnerships that have had success and have followed “open science principles without explicitly stating so in their vision or mission [16, p. 2191].” These examples from the field give evidence against the need for post-secondary institutions to focus on IP agreements to gain industry partners. The focus of [16] on chemical engineering contributes to understanding the complexities of open science practices in engineering. Their paper is a reminder that policy can significantly impact how quickly research moves towards open science while offering positive examples. Given that [16] points to institutions who are failing to incentivize data sharing and open science practices, for engineering in Canada’s post-secondary institutions, the perception that there is an unwillingness to share data is not necessarily a disciplinary norm but could be seen because of lack of policy that provides clear guidelines on what is required of the individual researcher or research team.

Considering the Tri-Agency’s Research Data Management policy and as [18] concludes in his report based on the 2015 UBC survey, “understanding the particular needs or habits within specific research areas can provide insight into how disciplines think about and work with data

[18, p. 14].” This study’s focus on engineering is intended to consider the research data sharing practices since the 2015 UBC study and provide further insight to assist the subject librarian’s understanding of the data sharing behaviour of engineers while reflecting on what supports could be adopted into their current work.

Methods

Survey Design

The online survey questionnaire was divided into three sections: Demographics, Research Data Practices, and Data Sharing Preferences. It included 29 questions and was adapted with permission from surveys completed by [14], [15] and [8]. Drafts were distributed in May and June 2022 for feedback and to test the Qualtrics survey instrument. Feedback on question order, questions to include and exclude, and word choice were addressed and modified by the author before survey distribution via Qualtrics.

The study was approved by the UBC Behavioural Research Ethics Board (BREB ID H22-00116) on June 9, 2022.

Data Collection

Engineering faculty emails were compiled from UBC’s Faculty of Applied Science website. 301 emails were distributed to faculty at both campuses in Vancouver and the Okanagan, British Columbia in July 2022 and included information about the survey and the link to the Qualtrics tool. Additionally, a notice with a link to the survey was submitted to the faculty and staff bi-weekly newsletter inviting participation. This could have resulted in non-faculty responses, but survey results indicate only faculty answered the survey. Out of 301 emails, 3 failed leaving 298 invitations distributed. The survey ran for one month, in which time 30 surveys were completed. To try and increase the response rate, the survey email invitation was re-sent during the last week of August when it was expected that more faculty would be available in preparation for Fall Term classes. The survey remained open for one week and 4 more surveys were completed in that time. A total of 34 responses were recorded in Qualtrics with 26 valid responses for a response rate of 9%. As the data collection was completed in the Qualtrics survey tool, Qualtrics was used for analysis in combination with Excel.

Results

Demographics

Of the 26 valid responses 91% hold a position as full professor, assistant, or associate professor [Table 1, Appendix A]. Email invitations would have reached faculty from 13 different departments, programs, and schools in the Faculty of Applied Science across two campuses. Responses did not come from every program or department but each of the larger departments and schools are represented in the results [Table 2, Appendix A]. Faculty at UBC may also hold cross-appointments with other departments, which is why the survey asked participants to select the one they most affiliate with. Participants were given an “Other” option should they fall outside of the Faculty of Applied Science and associate more closely with another department. The “Other” option was intended to also cover the School of Nursing, the School of Architecture and Landscape Architecture, and the School of Community and Regional Planning within the Faculty as an invitation was sent to the faculty and staff newsletter that would reach those populations. However, the “Other” option was not selected by any respondents meaning no responses needed to be excluded based on affiliation. Research lab affiliations were also counted, but most (65%) did not identify with a research center. Information about gender identity was also collected with 61% identifying as men, 31% identifying as women and 8% preferred not to answer. No participants selected non-binary person. While not the focus of this study, rank and gender as seen in Tables 3 and 4 [Appendix A] may reflect the shifting demographics in engineering.

Research Data Management

In the survey’s Research Data section participants were asked questions about how they work with data, document them, and store them. Research data was found to be predominantly numerical in nature (84%) followed by text (76%) and software data (64%). For the average research project, UBC engineering researchers work with moderate amounts of data with file sizes ranging from 1 GB of data to TBs of data. This may reflect the varied and sometimes interdisciplinary nature of engineering research with some areas doing more qualitative work while most is quantitative in nature. Files sizes may vary depending on the project. As one researcher commented: “No single choice would be appropriate as I have engaged in projects that cover the entire range. The distribution is too broad to give a meaningful ‘average research project’.” When it comes to analyzing their data, researchers showed a preference for working with Excel (85%) followed by Python (66%) and Matlab (58%).

In response to the question: Is there sufficient documentation and description retained in the same file, folder, or document as the research data for another person outside your lab to understand and use the research data, only 27% answered ‘Yes.’ The 2015 survey only found 12% of the engineering responses recorded ‘Yes’ to the same question. A researcher may not know documentation needs to be included or more specifically what type of documentation needs to be included with their data for someone else to interpret their research. It demonstrates that in many cases data is not ready for deposit, but it is unclear given the scope of the survey what amount of description and types of documentation is being generated to accompany their data.

In terms of storage, Table 5 shows a preference for engineering researchers to keep their data close to where they are working with that data on their computer or within a shared drive. External data repositories are being used, but not widely. However, they may be preferred once the project is no longer active and deposit data at the time of publication as the literature noted.

TABLE V
INDICATE WHERE YOU STORE RESEARCH DATA DURING AN ACTIVE PROJECT(S).

Data Storage Location	**Count**	**Percentage**
Computer or laptop hard drive (i.e. local hard drive)	24	92%
Shared drive/ UBC network storage or departmental server (e.g. Home drive, TeamShare, SharePoint, OneDrive)	19	73%
External drive	16	62%
Cloud/web-based solution (e.g. Dropbox, Google Drive)	9	35%
Hard drive of the instrument/sensor which generates the data	8	31%
High Performance Computing (HPC) resources (e.g. West Grid, ARC Sockeye)	6	23%
External data repository (e.g. GitHub, Dryad, Figshare, Dataverse)	4	15%
Physical copy retained (in boxes, cabinets, etc.)	3	12%
Not sure	0	0%
Other, please specify:	0	0%

Respondents who retain their data for more than 10 years may continue to keep raw and processed data until the data becomes inaccessible or lost. Those who retain data indefinitely indicated little planning for long term preservation. 58% keep their raw data until it is no longer accessible or is lost while 65% of the processed data that could be shared is also kept until it is no longer accessible or is lost. The introduction of the Tri-Agency's policy can be expected to shift data preservation in engineering practice.

Researchers were asked to select their primary funding source within the last five years or expected funding source in the next five years. More than one funding body could be selected as projects and labs may receive funding from a variety of sources. All three of the Tri-Agencies, NSERC, SSHRC, and CIHR have been highlighted in Figure 1. As expected NSERC dominates. Industry also features prominently, which includes Mitacs, a "national, not-for-profit research and training organization dedicated to advancing collaborations between industry, academia and government in Canada [19, np]." Partnerships with industry were expected to figure highly in the results, which may require additional considerations on advising how researchers manage their data.

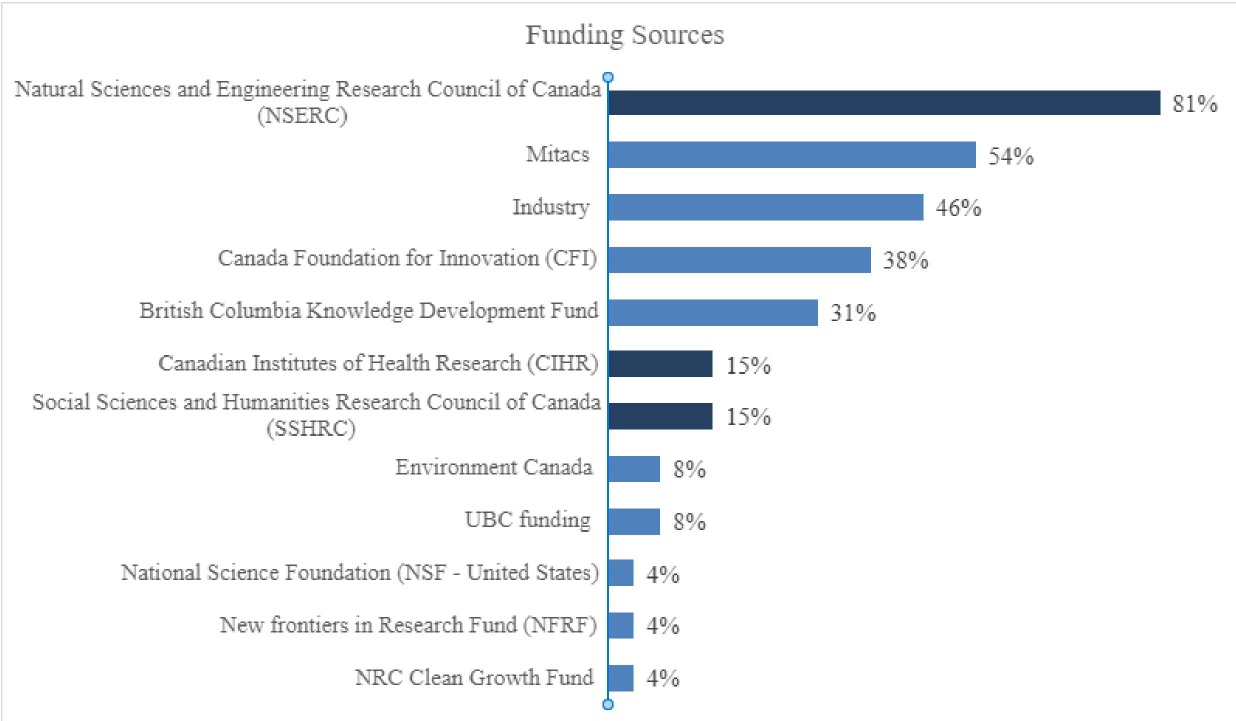

Fig. 1. *Which funding sources have you used within the past 5 years, or are planning to apply for in the next 5 years?*

Data management plans (DMP) are encouraged by the Tri-Agencies' policy but are not required [20]. More than half (54%) of survey respondents have never completed a DMP with 12% selecting that they were "Not sure" if they had completed a DMP. Researchers may be unfamiliar with the specifics of managing their research data throughout the data lifecycle. Of the 9 respondents who selected "Yes" when asked about DMP completion, 7 of them are NSERC funded. Given the high number of Tri-Agency funded research within engineering, they could benefit from DMP guidance. While a similar question about DMPs was not included in the 2015 survey, participants were asked about their level of interest in workshops and consultations on DMPs to fulfill funding agency requirements. In 2015 87% of faculty were interested in workshops and consultations. Considering that more than half of this current study have never completed a DMP, there is room here for the librarian to assist. Librarians can provide DMP templates or offer support with a more hands-on approach writing a DMP if embedded in the research team. This would depend on the capacity of the individual librarian.

Data Sharing

In the introduction to this section of the survey respondents were reminded of the upcoming Tri-Agencies' RDM policy highlighting the DMP requirements and data deposit. In addition to collecting data sharing practices and preferences, information about open access preferences was collected to gather some insight on overall willingness in the field to participate in open science practices.

When asked to select their methods for sharing, personal request was the most common method (46%) followed by supplementary file when submitting their article for publication (42%). As more data deposit will be required from funding agencies and journals, sharing by personal request may decrease. In the 2015 results 69% shared by personal request and 31% submitted supplementary files with publication.

Using a general or subject repository for sharing data was as common as those who selected that they are not currently sharing [Table 6]. Of the 7 responses who did select repository use, the most cited location for sharing data was GitHub. All 7 respondents using GitHub may also be using another location such as Zenodo or Figshare as was noted in their free text answers. It should be clarified by the author that GitHub is not a data repository, but rather a code repository. The question in the survey included GitHub as an option considering it as a *platform* rather than a repository.

TABLE VI

WHICH METHODS OF SHARING DATA DO YOU CURRENTLY USE?

Methods for Sharing Data	**Count**	**Percentage**
Share by personal request only	12	46%
As part of supplementary files to a peer-reviewed research publication (e.g. journal article or book chapter)	11	42%
Share online with restricted access	8	31%
Not currently sharing	7	27%
Upload online to an institutional or personal website	7	27%
Share in a general or discipline-specific repository or platform, such as Dryad, Dataverse, Figshare, FRDR, GitHub, OSF.	7	27%
Publish as a stand-alone peer-reviewed data publication (e.g. an article in a dedicated data journal)	3	12%

Importance of sharing their data showed mixed results, but most selected some level of importance in sharing data [Table 7] ranking the benefits positively with recognition that it encourages collaborative science (73%), supports open access to knowledge (65%), provides safeguards against misconduct (58%), encourages interdisciplinary research (58%), and helps in the training of the next generation of researchers (58%) [Table 8]. This reflects what was found in the literature, the recognition of the benefits to shared data. However, not all attitudes were positive with 4 respondents selecting “I see no benefits to sharing my data.” Given the opportunity to expand further to this question one respondent, a professor, provided additional context adding: “Since a lot of my work leads to patents, I would never share my data openly.”

TABLE VII

HOW IMPORTANT IS IT TO YOU THAT YOUR RESEARCH DATA IS SHARED?

Data Sharing Importance	**Count**	**Percentage**
Very important	5	19%
Important	7	27%
Moderately important	6	23%
Slightly important	4	15%
Not important	4	15%

TABLE VIII

WHAT BENEFITS DO YOU SEE TO SHARING YOUR RESEARCH DATA?

Research Data Sharing Benefits	**Count**	**Percentage**
Data sharing encourages collaborative science	19	73%
Data sharing supports open access to knowledge	17	65%
Data availability provides safeguards against misconduct, data fabrication and falsification	15	58%
Data sharing and/or replication studies help in the training of next generation researchers	15	58%
Data sharing encourages interdisciplinary research	15	58%
Data sharing moves my field of research forward	13	50%
Well-maintained data helps retain data integrity	12	46%
Data sharing enables my data to be cited and increases my research impact	11	42%
Re-analysis of data helps verify results	10	38%
Data sharing reduces redundant data collection	7	27%
I see no benefits to sharing my data	4	15%
Other, please specify:	2	8%

It is helpful to see researchers’ perceptions towards shared data. In practice who they choose to share their data with varies depending on if it is before or after publication [Figure 2]. Even if they are using external repositories during the active phase of a project, it does not mean that data is widely shared. It seems that only after publication is this group willing to share data. Only a small percentage would not share after publication (8%).

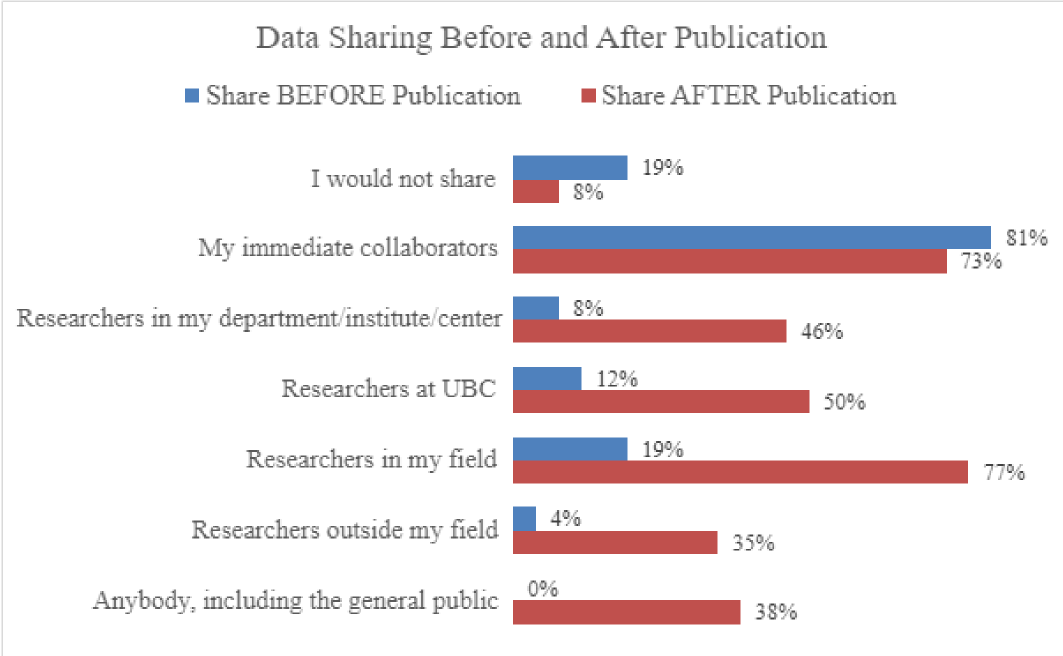

Fig. 2. Results from Q21: *With whom do you think it is important to share research data BEFORE its publication?* Q22: *With whom do you think it is important to share research data AFTER its publication?*

Given the level of importance, recognition of benefits, and willingness to share data particularly after publication, there doesn't appear to be a "cultural inertia" [2] amongst the faculty surveyed here. Questions that address potential barriers provide some reasons why engineering researchers may not be actively sharing data. Asked if there were any embargoes or restrictions on their data 23 replied out of the 26 valid survey responses and 30% noted that there are no restrictions or embargoes that would affect sharing their data with others. However, most selected choices that reveal some limitations when it comes to intellectual property rights and confidentiality restrictions that reflect what was found in the literature [Table 9].

TABLE IX

WHICH OF THE FOLLOWING RESTRICTIONS OR EMBARGOES MAY LIMIT YOUR ABILITY TO SHARE YOUR DATA WITH OTHERS? SELECT ALL THE APPLY.

Restrictions or Embargoes	**Count**	**Percentage**
There are no restrictions or embargoes on sharing my data with others	7	30%
Sharing my data may jeopardize Intellectual Property rights	7	30%
My data are subject to privacy or confidentiality restrictions (e.g. patient data)	7	30%
I need to publish my data before I can share them	5	22%
I have a contractual obligation with a third party	5	22%
I am unsure if I am allowed to share my data	4	17%
I plan to file for a patent	3	13%
Other, please specify	2	9%

My data are a matter of public safety or of a sensitive nature	1	4%
I work with or interact with Indigenous data	1	4%

Comments from responders noted that it is dependent on the specifics of a project and who the sponsors are. As one Associate Professor noted: "It depends on the project - some data is commercial/commercial derived, some research project IP rules are specific."

Who they partner with and the type of data influences how that information is shared. Uncertainty about data sharing (17%) could be tied to some of the other restrictions listed. Those who selected: "I am unsure if I am allowed to share my data" also chose other options here including: "I need to publish my data before I can share them" and "I plan to file for a patent." There could be lack of clarity around what can be done with data if there are no clear restrictions placed on research data sharing. When asked who they would share with if no restrictions or embargoes were placed on their data, only 3 (n = 25) said "Nobody." This again points to a willingness within the field when it comes to data sharing.

Legal and privacy restrictions may be blocking practices, but when asked what reasons they had for not sharing data, insufficient time (52%) was the first choice followed by data they are still working with and lack of standards to make data usable by others [Figure 3]. Insufficient time did come up in the literature but was not as prominent as the survey results here. The earlier UBC study done in 2015 looking at science and engineering also had insufficient time ranked highly, but other options such as, "they are incomplete or not finished" and "I am willing to share them" ranked higher than insufficient time.

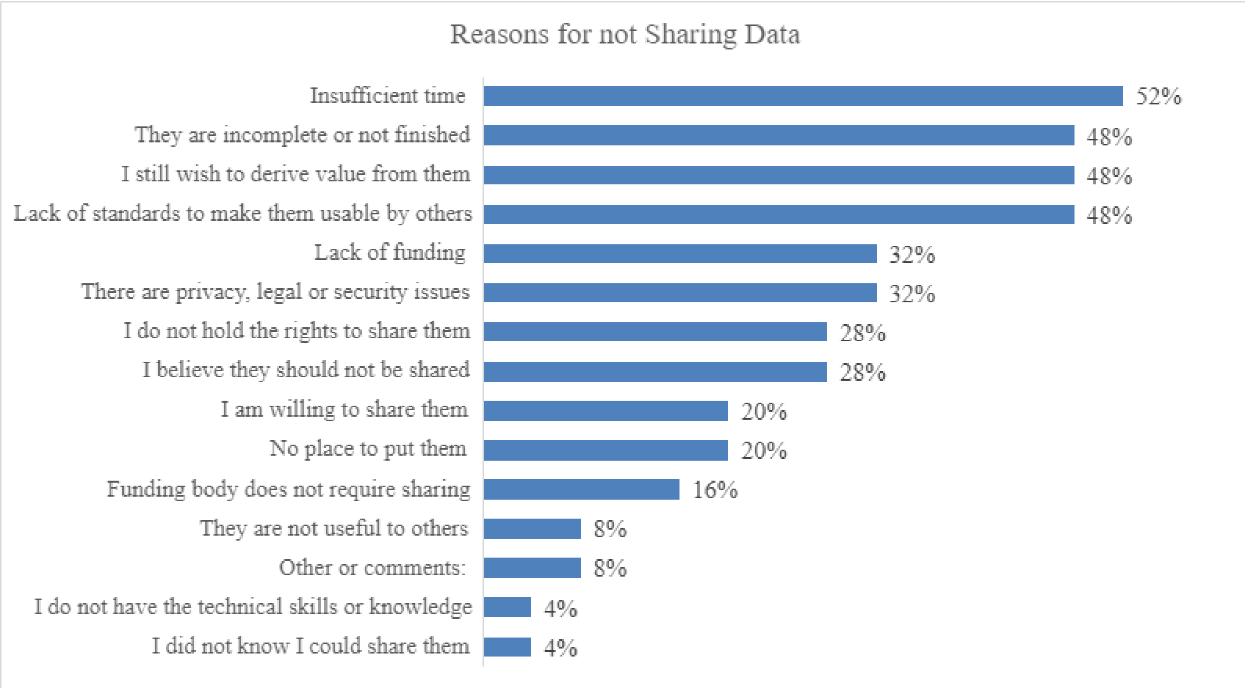

Fig. 3. *What, if any, are the reasons you would not be willing to share your research data and associated methods?*

Comments in the free text question to conclude the survey demonstrate some additional challenges that reflect some findings in the literature. One Lecturer noted that they would "share my data, but I am in a less powerful position so someone else could steal my work. Unless there is a direct benefit for me and I am recognized for sharing my data."

It is worth noting that the respondents who said they do not believe they should share their data, nor do they see any benefits to sharing their data all hold the rank of full Professor. Given the comment above, rank may be an influencer.

In one final comment one Professor said: "I see absolutely no need to share raw data. That's what research publications are for. Nothing fundamental has changed from the way things have always been. Interested parties can read my papers and glean the importance of the work from that. They do not need access to my raw data."

Open Science

The results from the questions on data sharing show more mixed responses and it is encouraging when considering the possibilities for more open and collaborative research if restrictions and embargoes are not placed on engineering data. In general, engineering appears willing to adopt open science practices. Questions that asked about open access practices and preferences intended to provide a more fulsome picture of attitudes towards open science. The Tri-Agency Council introduced their open access policy in 2015 requiring researchers to publish open access if possible or deposit an open access copy into a repository for discovery [10]. In the seven years since the policy went into effect, it is evident that most researchers are either already publishing open access or plan to in the future [Table 10 and Table 11].

TABLE X

HAVE YOU PUBLISHED AN ARTICLE IN AN OA JOURNAL?

Published OA	**Count**	**Percentage**
Yes	17	65%
No, but I plan to in the future	3	12%
No, I have no plan to publish in an OA journal	5	19%
No, not sure about this	1	4%

TABLE XI

HAVE YOU DEPOSITED ARTICLES INTO AN OA REPOSITORY?

OA Deposit	**Count**	**Percentage**
Yes	13	52%
No, not sure about this	6	24%

No, I have no plan to do this	3	12%
No, but I plan to in the future	2	8%
Other or comments:	1	4%

Preference for OA publishing may suggest that OA preference is not just a result of fulfilling funding requirements [Table 12]. This is not unlike the willingness to share data after publication. Funding requirements will impact if and how data is shared, but the motivation may already exist.

TABLE XII

DO YOU PREFER TO PUBLISH IN OA JOURNALS RATHER THAN SUBSCRIPTION-BASED JOURNALS?

OA Preference	**Count**	**Percentage**
Yes, I prefer OA journals only if I personally do not have to pay author fees	9	35%
Yes, I prefer OA journals even if I personally must pay author fees	7	27%
I don’t have a preference; it all depends on which journals have higher reputation in my field	5	19%
No, I prefer conventional subscription-based journals	4	15%
Other or comments:	1	4%

Discussion

The researchers’ lack of time, lack of incentives, and lack of standards available to provide guidance on preparing data for deposit are significant barriers. Even with recognition of the benefits to sharing data that encourages collaboration and supports many of the tenets of open science, these three main barriers that may be preventing engineering data from being shared will have to be addressed. In Canada one of the ways existing or future barriers are being addressed is through institutional strategies. As of March 1, 2023 each post-secondary institution that receives funding from one of the Tri-Agencies was required to submit their institutional strategy for RDM [20]. These strategies are intended to assist the researcher as they adopt RDM practices ensuring data is well managed for each stage of the data life cycle.

For those researchers funded by NSERC, the gradual roll out of the policy will allow the time needed to become more familiar with preparing their data for deposit and librarians are well positioned to assist researchers. Subject librarians may opt to provide information on RDM best practices that can potentially help researchers address the lack of time issue. The time required to learn how to prepare their data for deposit should eventually eclipse any concerns about insufficient time.

Some specifics for consideration by subject librarians who support engineering include guidance on finding general, subject, or institutional repositories most suited for engineering data. External repositories were not widely used by the researchers in this survey, which means identifying appropriate repositories could help eliminate one barrier. Other areas for consideration could include guidance on licenses and discussion on the value of sharing data as a collaborative science practice. Outreach like this could move some to make their data as open as possible and as closed as necessary. Additionally, if aspects of RDM practices are introduced into graduate and even undergraduate education, it begins to build better data stewards and could even help prepare students to work under supervision of a faculty researcher or within a research team, which graduate students inevitably may be doing. Librarians can encourage students and future researchers to be knowledgeable on RDM practices that will help with preparing, sharing, and preserving their data.

For the subject librarian whose responsibilities may include reference services, teaching, supervising, collection development, participating in various committees and possibly being liaison to multiple disciplines, RDM services may be a low priority. However, understanding the preferences and practices of the faculty and students can be a jumping off point to incorporating RDM into existing work. Identifying funding agencies for liaison areas and learning policy details relevant to your faculty is not dissimilar to identifying open access policies for a journal faculty may be considering for publication. Data literacy instruction for students and faculty is one way to further develop skills and gain expertise in this area. It is not unfamiliar territory for a subject librarian to learn a new tool or database that they will later teach to their students. As always it will depend on the individual librarian's capacity to include additional services and if given priority may require that other services be reduced. For UBC Library one of its core values is "Openness" within its Strategic Directions that states it will "Lead and collaborate to advance open scholarship" [21]. What services and supports are offered may also depend on an individual libraries' priorities.

Conclusion

The initial intent for this study was to consider the tension engineers may experience when faced with data deposit when they are working with industry partners. However, the literature and survey results reveal a more complex relationship between engineers and data sharing. The literature and survey found a willingness to share, but putting this into practice is quite challenging. It is perhaps not too surprising to learn that researchers are comfortable informally sharing data by request, or more formally attaching it to a publication where the journal can manage data access or provide a link to a supplementary file. Data deposit to comply with a funding policy requires more stringent RDM practices. The Tri-Agency's policy will impact engineering data sharing behaviour in Canada.

This study provides a snapshot of pre-policy practices and surfaces many common barriers to data sharing from the literature. Other challenges may emerge as policy implementation unfolds such as interoperability issues and lack of infrastructure [16], [22]. The expectation for engineering is that support will be needed given that there is no history of data sharing or disciplinary norms.

It will take more than a change in policy to shift perceptions of open data, but FAIR data in the very least will encourage discoverability, transparency and reproducibility. And as this study demonstrated engineers understand the value of open data even if they are not quite prepared to take their data to that next level.

Study Limitations

The survey results contribute to what has been found in the literature but given the response rate (9%) is low, it cannot be generalized. Survey results were described with an attempt to not make generalizations about the field, but rather contribute to the existing literature. Results from the survey did align with previous studies. An additional limitation could be sampling bias as respondents could self-select participation. Those with more interest in the topic may have chosen to complete the survey over others.

References

[1] J. Kim, "Overview of disciplinary data sharing practices and promotion of open data in science," *Sci Ed*, vol. 6, no. 1, pp. 3–9, Feb. 2019, doi: 10.6087/kcse.149.

[2] D. R. Berg and K. E. Niemeyer, "The case for openness in engineering research," *F1000 research*, vol. 7, pp. 501–501, 2018. [Online]. Available: https://bit.ly/3SH2PpQ

[3] A. Johri, S. Yang, M. Vorvoreanu, and K. Madhavan, "Perceptions and Practices of Data Sharing in Engineering Education," *Advances in engineering education*, vol. 5, no. 2, 2016, [Online]. Available: https://bit.ly/3Ur54hJ

[4] B. Suhr, J. Dungl, and A. Stocker, "Search, reuse and sharing of research data in materials science and engineering—A qualitative interview study," *PLoS ONE*, vol. 15, no. 9 September, Sep. 2020, doi: 10.1371/journal.pone.0239216.

[5] C. A. Wiley and M. H. Burnette, "Assessing Data Management Support Needs of Bioengineering and Biomedical Research Faculty," *JeSLIB*, vol. 8, no. 1, p. e1132, Mar. 2019, doi: 10.7191/jeslib.2019.1132.

[6] S. Wu and A. Worrall, "Supporting successful data sharing practices in earthquake engineering," *Library hi tech*, vol. 37, no. 4, pp. 764–780, 2019, doi: 10.1108/LHT-03-2019-0058.

[7] Government of Canada, "Tri-Agency Statement of Principles on Digital Data Management," Jan. 21, 2021. https://science.gc.ca/site/science/en/interagency-research-funding/policies-and-guidelines/research-data-management/tri-agency-statement-principles-digital-data-management (accessed Nov. 24, 2022).

[8] E. Barsky, M. Mitchell, and Buhler, Jeremy, "UBC Research Data Management Survey: Science and Engineering." Borealis, 2015. [Online]. Available: https://doi.org/10.5683/SP2/9VEAT9

[9] K. E. Niemeyer, "Open science and the future university researcher." Engineering Archive, Feb. 07, 2017. doi: 10.31224/osf.io/2zcj3.

[10] Government of Canada, "Tri-Agency Open Access Policy on Publications," Dec. 21, 2016. https://science.gc.ca/site/science/en/interagency-research-funding/policies-and-guidelines/open-access/tri-agency-open-access-policy-publications (accessed Nov. 12, 2022).

[11] C. Wiley and W. H. Mischo, William H., "Data Management Practices and Perspectives of

Atmospheric Scientists and Engineering Faculty," *Issues in Science & Technology Librarainship*, vol. Fall, no. 85, 2016, doi: 10.5062/F43X84NJ.

[12] C. Wiley, "The Case for Data-sharing Policies and FAIR Sharing Principles: Analyzing Journals and Articles of Engineering and Medical Faculty," in *2020 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual Online: ASEE Conferences, Jun. 2020, p. 35295. doi: 10.18260/1-2--35295.

[13] M. L. Mallasvik and J. T. Martins, "Research data sharing behaviour of engineering researchers in Norway and the UK: uncovering the double face of Janus," *Journal of documentation*, vol. 77, no. 2, pp. 576–593, 2021 2020, doi: 10.1108/JD-08-2020-0135.

[14] R. Melero and C. Navarro-Molina, "Researchers' attitudes and perceptions towards data sharing and data reuse in the field of food science and technology," *Learned Publishing*, vol. 33, no. 2, pp. 163–179, Apr. 2020, doi: 10.1002/leap.1287.

[15] Y. Zhu, "Open-access policy and data-sharing practice in UK academia," *Journal of Information Science*, vol. 46, no. 1, pp. 41–52, Feb. 2020, doi: 10.1177/0165551518823174.

[16] K. Hart, S. An, A. M. Edwards, R. Mahadevan, E. R. Master, and E. A. Edwards, "Could open science stimulate industry partnerships in chemical engineering university research?," *Canadian journal of chemical engineering*, vol. 99, no. 10, pp. 2186–2194, 2021, doi: 10.1002/cjce.24077.

[17] C. Tenopir *et al.*, "Data Sharing by Scientists: Practices and Perceptions," *PLoS ONE*, vol. 6, no. 6, p. e21101, Jun. 2011, doi: 10.1371/journal.pone.0021101.

[18] E. Barsky, "Research Data Management Survey - Science and Engineering". 2015. [Online] Available: http://hdl.handle.net/2429/61813

[19] "About Mitacs," *Mitacs*, Sep. 19, 2014. https://www.mitacs.ca/en/newsroom/media-kit/about-mitacs (accessed Nov. 12, 2022).

[20] Government of Canada, "Tri-Agency Research Data Management Policy," Mar. 15, 2021. https://science.gc.ca/site/science/en/interagency-research-funding/policies-and-guidelines/research-data-management/tri-agency-research-data-management-policy (accessed Nov. 24, 2022).

[21] "Strategic Framework," *About UBC Library*, Nov. 20, 2018. https://about.library.ubc.ca/about-us/strategic-framework/ (accessed Feb. 26, 2023).

[22] T. Austin, K. Bei, T. Efthymiadis, and E. P. Koumoulos, "Lessons Learnt from Engineering Science Projects Participating in the Horizon 2020 Open Research Data Pilot," *Data*, vol. 6, no. 9, pp. 96–96, 2021.

APPENDIX A

DEMOGRAPHICS

TABLE I

WHAT IS YOUR RANK AT UBC?

Rank	Count	Percentage
Professor	10	38%
Assistant Professor	7	27%
Associate Professor of Teaching	3	12%
Associate Professor	3	12%
Lecturer	1	4%
Professor of Teaching	1	4%
Assistant Professor of Teaching	1	4%
Sessional Lecturer	0	0%
Adjunct Professor	0	0%
Emeritus Professor	0	0%
Research Associate	0	0%

TABLE II

WHAT DEPARTMENT, SCHOOL, OR PROGRAM ARE YOU MOST CLOSELY AFFILIATED?

Department, school or program	Count	Percentage
Civil Engineering, Department of	4	15%
Mechanical Engineering, Department of	4	15%
Materials Engineering, Department of	4	15%
UBC Okanagan - School of Engineering	4	15%
Electrical and Computer Engineering, Department of	3	12%
Chemical and Biological Engineering, Department of	3	12%
Biomedical Engineering, School of	3	12%
Mining Engineering, Norman B. Keevil Institute of	1	4%

In Table 3, the high percentage of faculty holding the rank of Professor who identify as a man compared to the Assistant Professor rank being predominantly women (71%) may reflect the shifting demographics in engineering as more women have entered the field coupled with engineering programs that have made additional efforts to hire women faculty.

TABLE III

RANK AND GENDER IDENTITY

Rank	Woman	Man	Non-binary person	Prefer not to answer
Professor	0%	80%	0%	20%
Assistant Professor	71%	29%	0%	0%
Associate Professor	33%	67%	0%	0%
Associate Professor of Teaching	33%	67%	0%	0%
Lecturer	0%	100%	0%	0%
Assistant Professor of Teaching	100%	0%	0%	0%
Professor of Teaching	0%	100%	0%	0%

TABLE IV

AGE AND GENDER IDENTITY

Gender Identity	Under 25	25-34	35-44	45-54	55-64	65 and over
Woman	0%	50%	25%	25%	0%	0%
Man	0%	6%	31%	25%	31%	6%
Non-binary person	0%	0%	0%	0%	0%	0%
Prefer not to answer	0%	0%	0%	100%	0%	0%

APPENDIX B

SURVEY QUESTIONNAIRE

Section 1. Demographic & General Questions

In this section you will be asked basic questions about your rank, departmental and research affiliations and funding sources to help put your answers into context.

1. Please indicate your rank at the University of British Columbia:
   - ❑ Postdoctoral Fellow
   - ❑ Lecturer
   - ❑ Senior Lecturer
   - ❑ Adjunct Professor
   - ❑ Assistant Professor
   - ❑ Professor (including University Professor)
   - ❑ Professor Emeritus
   - ❑ Research associate
   - ❑ Other, please specify: __________________

2. Please select your department, school or program at the University of British Columbia that you are most closely affiliated:
   - ❑ UBC Okanagan - School of Engineering
   - ❑ Biomedical Engineering, School of
   - ❑ Chemical and Biological Engineering, Department of
   - ❑ Civil Engineering, Department of
   - ❑ Electrical and Computer Engineering, Department of
   - ❑ Engineering Physics
   - ❑ Environmental Engineering
   - ❑ Geological Engineering
   - ❑ Integrated Engineering
   - ❑ Manufacturing Engineering
   - ❑ Materials Engineering, Department of
   - ❑ Mechanical Engineering, Department of
   - ❑ Mining Engineering, Norman B. Keevil Institute of
   - ❑ Other, please specify: _________________

3. Please indicate your research center, if applicable. Select all that apply:
   - ❑ I am not affiliated with a research center
   - ❑ Advanced Materials & Process Engineering Laboratory (AMPEL)
   - ❑ BioProducts Institute (BPI)
   - ❑ Clean Energy Research Centre (CERC)
   - ❑ Institute for Computing Information & Cognitive Systems (ICICS)
   - ❑ Other, please specify: __________________

4. Which funding sources have you used within the past 5 years, or are planning to apply for in the next 5 years? Please exclude funding earmarked exclusively for operations and infrastructure. Select all that apply:
    - ❑ British Columbia Knowledge Development Fund
    - ❑ Canada Foundation for Innovation (CFI)
    - ❑ Canadian Institute of Advanced Research (CIFAR)
    - ❑ Canadian Institutes of Health Research (CIHR)
    - ❑ Canadian Space Agency
    - ❑ Environment Canada
    - ❑ Industry
    - ❑ Mitacs
    - ❑ National Natural Science Foundation of China
    - ❑ National Science Foundation (NSF)
    - ❑ Natural Sciences and Engineering Research Council of Canada (NSERC)
    - ❑ Science and Technology Facilities Council
    - ❑ Social Sciences and Humanities Research Council of Canada (SSHRC)
    - ❑ Other, please specify: _______________

5. What is your gender identity?
    - ❑ Woman
    - ❑ Man
    - ❑ Non-binary person
    - ❑ Prefer not to answer

6. What is your age?
    - ❑ Under 25
    - ❑ 25-34
    - ❑ 35-44
    - ❑ 45-54
    - ❑ 55-64
    - ❑ 65 and over

7. How many years have you worked as an academic researcher (including the period doing a research degree, e.g., PhD)?

Section 2. Research Data

In this section you will be asked questions about your research data, including how you work with data, document them and store them.

8. As part of your research have you completed a Data Management Plan (DMP) to help guide how you store, protect, share and preserve your data?
    - ❑ Yes
    - ❑ No
    - ❑ Not sure

9. Does your primary funding agency require you to provide a DMP?
    - ❑ Yes
    - ❑ No
    - ❑ Not sure

10. Generally, estimate the combined size of the data files you use in an average research project? Select one:
    - ❑ Less than 1 gigabyte
    - ❑ 1-9 gigabytes
    - ❑ 10-49 gigabytes
    - ❑ 50-99 gigabytes
    - ❑ 100-1000 gigabytes (up to 1 terabyte)
    - ❑ 1-10 terabytes
    - ❑ More than 10 terabytes
    - ❑ Not sure
    - ❑ Not Applicable, please explain: ________________

11. Which of the following best describes the type of research data you generate or use in a typical research project. Select all that apply:
    - ❑ Audio - (e.g. .aiff, .mp3, .wav)
    - ❑ Geospatial - (e.g. raster, vector, grid)
    - ❑ Instrument specific {e.g. Olympus Confocal Microscope Data Format, FLIR Infrared Camera (SEQ))
    - ❑ Models - (e.g. 3D, statistical, similitude, macroeconomic, causal)
    - ❑ Multimedia - (e.g. JPEG, TIFF, MPEG, Quicktime, Bitmap)
    - ❑ Numerical - (e.g. CSV, MAT, XLS, SPSS)
    - ❑ Software - (e.g. Ansys, AutoCAD, Matlab, Solidworks, C, Python, Ruby, PHP)
    - ❑ Text - (e.g. TXT, DOC, PDF, RTF, HTML, XML)
    - ❑ Video - (e.g. .avi, .mov, .mp4)
    - ❑ Other, please specify: ___________

12. Please indicate any software used for analysis or manipulation of your research data, if applicable. Select all that apply:
    - ❑ Excel
    - ❑ JMP (JMP Pro, JMP Graph Builder App)
    - ❑ LabVIEW
    - ❑ MATLAB
    - ❑ Python
    - ❑ R
    - ❑ SimulationX
    - ❑ Solidworks
    - ❑ STK (Systems Tool Kit)
    - ❑ Other, please specify: _____________

13. Please indicate where you store research data during an active project(s). Select all that apply:
    - ❑ External drive

- ❑ Computer or laptop hard drive (i.e. local hard drive)
- ❑ Hard drive of the instrument/sensor which generates the data
- ❑ Shared drive/ UBC network storage or departmental server (e.g. Home drive, TeamShare, SharePoint, OneDrive)
- ❑ Cloud/web-based solution (e.g. Dropbox, Google Drive, Amazon Cloud)
- ❑ External data repository (e.g. Protein Data Bank, Cambridge Structural Database, GitHub, Dryad, Figshare, Dataverse)
- ❑ High Performance Computing (HPC) resources (e.g. West Grid, ARC Sockeye)
- ❑ Physical copy retained (in boxes, cabinets, etc.)
- ❑ Not sure
- ❑ Other, please specify: ________________

14. Use the chart below to indicate the length of time and project completion that you typically intentionally keep each type of research data. Project completion could include until a publication or a patent approval, for example.

	I only keep data for the length of the project	Less than 3 years	Between 3-5 years	Between 5-10 years	More than 10 years	Until the data becomes inaccessible or lost
Source material/Raw data						
Intermediate/ working data						
Processed data ready for publication. Processed data may include supporting information such as synthesis methods						

Section 3. Data Sharing

The Tri-Agency made up of the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), and the Social Sciences and Humanities Research Council (SSHRC) is phasing in a digital data policy coming into effect in Spring 2023. It will require the completion of a Data Management Plan (DMP) in some cases and will also require that "all digital research data, metadata and code that directly support the research conclusions in journal publications and pre-prints that arise from agency supported research" be deposited into a repository.

The current policy does not require that deposited data be shared.

In this section you will be asked about your current practices and opinions on communicating your research and sharing your research data.

15. Have you published an article in an open-access (OA) journal? (An OA journal means the articles are made freely accessible online to the public by the publishers, which often requires the author pay an article processing charge (APC). This is in contrast to subscription-based journal that requires reader-pay.)

- ❑ Yes
- ❑ No, but I plan to in the future
- ❑ No, I have no plan to publish in an OA journal
- ❑ No, not sure about this
- ❑ Not applicable (I haven't or don't publish research articles)
- ❑ Other or comments: ______________

16. In general, do you prefer to publish research articles in open-access journals rather than subscription-based journals if they have similar reputation or ranking of citation impact?
    - ❑ Yes, I prefer OA journals even if I personally must pay author fees
    - ❑ Yes, I prefer OA journals only if I personally do not have to pay author fees
    - ❑ No, I prefer conventional subscription-based journals
    - ❑ I don't have a preference; it all depends on which journals have higher reputation in my field
    - ❑ I don't have enough information on this matter
    - ❑ Not applicable (I don't produce research articles)
    - ❑ Other or comments: _________________

17. Have you deposited your research articles (published or working paper) in an open-access online repository (e.g. institutional repository such as UBC's cIRcle, disciplinary repository, etc.)
    - ❑ Yes
    - ❑ No, but I plan to in the future
    - ❑ No, I have no plan to do this
    - ❑ No, not sure about this
    - ❑ Not applicable (I haven't or do not produce research articles)
    - ❑ Other or comments: ___________________

18. How important is it to you that your research articles are freely accessible online to everyone? 1 being "Not important" and 5 being "Extremely important"
    1. Not important
    2. Slightly important
    3. Moderately important
    4. Important
    5. Very important

19. How important is it to you that your research data is shared? 1 being "Not important" and 5 being "Very important."
    1. Not important
    2. Slightly important
    3. Moderately important
    4. Important
    5. Very important

20. What benefits do you see to sharing your research data? Select all that apply. If you see no benefits, choose 'I see no benefits to sharing my data'.
    - ❑ I see no benefits to sharing my data

- ❑ Data availability provides safeguards against misconduct, data fabrication and falsification
- ❑ Data sharing and/or replication studies help in the training of next generation researchers
- ❑ Data sharing enables my data to be cited and increases my research impact
- ❑ Data sharing encourages collaborative science
- ❑ Data sharing encourages interdisciplinary research
- ❑ Data sharing moves my field of research forward
- ❑ Data sharing reduces redundant data collection
- ❑ Data sharing supports open access to knowledge
- ❑ Re-analysis of data helps verify results
- ❑ Well-maintained data helps retain data integrity
- ❑ Other, please specify: __________________________

21. With whom do you think it is it important to share research data BEFORE its publication? Select all that apply. If you would not share your data, choose ‘I would not share.”
    - ❑ I would not share
    - ❑ My immediate collaborators
    - ❑ Researchers in my department/institute/centre
    - ❑ Researchers at UBC
    - ❑ Researchers in my field
    - ❑ Researchers outside my field
    - ❑ Anybody, including the general public

22. With whom do you think it is it important to share research data AFTER its publication? Select all that apply. If you would not share your data, choose ‘I would not share.”
    - ❑ I would not share
    - ❑ My immediate collaborators
    - ❑ Researchers in my department/institute/centre
    - ❑ Researchers at UBC
    - ❑ Researchers in my field
    - ❑ Researchers outside my field
    - ❑ Anybody, including the general public

23. Is there sufficient documentation and description (for example, readme, file naming, defined variables, scripts to run, etc.) retained in the same file, folder or document as the research data for another person outside your lab to understand and use the research data?
    - ❑ Yes
    - ❑ No
    - ❑ Not sure

24. Which methods of sharing your research data do you currently use? Select all that apply. If you do not currently share your data, choose ‘not currently sharing’.
    - ❑ Not currently sharing
    - ❑ Share by personal request only
    - ❑ Share online with restricted access

- ❑ Upload online to an institutional or personal website
- ❑ As part of supplementary files to a peer-reviewed research publication (e.g. journal article or book chapter)
- ❑ Publish as a stand-alone peer-reviewed data publication (e.g. an article in a dedicated data journal)
- ❑ Share in a general or discipline-specific repository or platform, such as Dryad, Dataverse, Figshare, FRDR, GitHub, OSF.

25. If you selected ‘deposit in a general or discipline-specific repository, such as ‘GitHub, Dryad, Dataverse, Figshare’, please specify: __________________

26. Some research data cannot be shared because of legal or privacy restrictions or embargoes. Which of the following restrictions or embargoes may limit your ability to share your data with others? Select all that apply. If there are no restrictions or embargoes, choose ‘there are no restrictions or embargoes on sharing my data with other parties’.
    - ❑ There are no restrictions or embargoes on sharing my data with other parties
    - ❑ I am unsure if I am allowed to share my data
    - ❑ I need to publish my data before I can share them
    - ❑ Sharing my data may jeopardize Intellectual Property rights
    - ❑ I plan to file for a patent
    - ❑ I have a contractual obligation with a third party
    - ❑ My data are subject to privacy or confidentiality restrictions (e.g. patient data)
    - ❑ My data are a matter of public safety or of a sensitive nature
    - ❑ I work with or interact with Indigenous data.
    - ❑ Other, please specify: ______________________

27. If your research data were not affected by such restrictions or embargoes, with whom would you be willing to share them? Select all that apply:
    - ❑ Nobody
    - ❑ My immediate collaborators
    - ❑ Researchers in my department/institute/centre
    - ❑ Researchers at UBC
    - ❑ Researchers in my field
    - ❑ Researchers outside my field
    - ❑ Anybody, including the general public

28. What, if any, are the reasons you would not be willing to share your research data and associated methods/algorithms? Select all that apply. If you are willing to share, choose ‘I am willing to share them’.
    - ❑ I am willing to share them
    - ❑ They are incomplete or not finished
    - ❑ I still wish to derive value from them
    - ❑ I do not have the technical skills or knowledge
    - ❑ I do not hold the rights to share them

- ❑ Funding body does not require sharing
- ❑ I believe they should not be shared
- ❑ I did not know I could share them
- ❑ Insufficient time
- ❑ Lack of standards to make them usable by others
- ❑ Lack of funding
- ❑ No place to put them
- ❑ They are not useful to others
- ❑ There are privacy, legal or security issues
- ❑ Other, please specify: ___________________________

29. Is there anything else you would like to comment on regarding data sharing?

Survey References

Barsky, Eugene; Mitchell, Marjorie; Buhler, Jeremy, 2019, "UBC Research Data Management Survey: Science and Engineering", https://doi.org/10.5683/SP2/9VEAT9

Melero, R., & Navarro-Molina, C. (2020). Researchers' attitudes and perceptions towards data sharing and data reuse in the field of food science and technology. *Learned Publishing*, *33*(2), 163-179. Doi:10.1002/leap.1287

With permission from the authors.

Zhu, Yimei. (2020). Open-access policy and data-sharing practice in UK academia. *Journal of Information Science*, *46*(1), 41-52.

With permission from the author.