3-18-2024

Data Management Sharing Plan: Fostering Effective Trans-Disciplinary Communication in Collaborative Research

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v. 4, n. 10, 2024

International Journal of Human Sciences Research

DATA MANAGEMENT SHARING PLAN: FOSTERING EFFECTIVE TRANS-DISCIPLINARY COMMUNICATION IN COLLABORATIVE RESEARCH

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Abstract[1]**:** This paper scrutinizes the integral role of Trans-Disciplinary Communication (TDC) in conceptualizing and implementing Data Management and Sharing (DMS) plans in alignment with federal guidelines such as those from NIH and NSF. We begin by dissecting existing federal mandates for research data management, elucidating their pivotal role in maintaining data integrity and enabling accessibility. Using a case study as our methodological approach, we exemplify how TDC can effectively enhance the dialogue and practices surrounding DMS plans, fulfilling the requirements imposed by funding organizations. Furthermore, this research offers a novel contribution to the ongoing discourse by highlighting how DMS plans are foundational in promoting effective TDC and, by extension, advancing discussions in areas like Diversity Equity and Inclusion (DEI), STEM Education, and Collaboration.
Keywords: *Data Management Sharing (DMS) Plan, Research Data Management, Data Transparency, Data Accessibility, Research Data Preservation, Data Sharing Guidelines, and Responsible Data Handling.*

INTRODUCTION

Before delving into the intricacies of a Data Management and Sharing Plan (DMSP), it is essential to establish a shared understanding of its components.

With growing demands for transparent and responsible data handling from funding organizations such as the National Science Foundation (NSF), the importance of a comprehensive DMSP cannot be overstated. This section aims to define DMSPs and shed light on their essential elements. Understanding a DMSP is more than a mere administrative requirement; it serves as a cornerstone for effective Trans-Disciplinary Communication (TDC), an increasingly relevant subject in modern research landscapes.

DEFINITION OF A DATA MANAGEMENT AND SHARING PLAN (DMSP)

DMSP stands for "Data Management and Sharing Plan," a formal document outlining the management, preservation, and sharing of research data during and after a project. Funding agencies, academic institutions, and scholarly journals increasingly require DMS plans to ensure transparency, accessibility, and ethical data management. The primary objective of a DMSP is to delineate the procedures and policies researchers will adhere to throughout the project lifecycle, typically covering data collection, organization, storage, preservation, and sharing protocols. A well-crafted DMSP not only bolsters the credibility of research findings but also promotes collaboration and enables the potential for data reusability among other researchers, thereby fostering a common language and shared vision.

In 2015, the National Science Foundation (NSF) renewed its commitment to increasing public access to the results of its funded research via the introduction of a public access plan called "Today's Data, Tomorrow's Discoveries[2]" (NSF, 2015). This plan aims to expedite the dissemination of critical research findings that extend the boundaries of knowledge and contribute to national long-term success. It is grounded in the principle that open and transparent communication of research results is crucial for fulfilling NSF's core mission of advancing scientific progress.

OTHER RELATED WORKS

To fully grasp the scope and significance of

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Marcos Cabobianco, Head of practical work (History), ``*Universidad de Buenos Aires*``, Argentina was the peer-editor of the final proofreading of the article.

2 It is also known as the NSF's Public Access Plan NSF 15-052 https://www.nsf.gov/pubs/2015/nsf15052/nsf15052.pdf

Data Management and Sharing Plans (DMSPs), it is essential to consider them in context. They must be examined within the broader frameworks established by various governing bodies and scholarly works. This section will provide a multifaceted analysis of DMSPs by exploring three crucial aspects: Federal Guidelines for Research Data Management, a Basic Bibliography for DMSPs, and the Importance of DMSPs in Research. Section 2.1 delves into the regulatory landscape by discussing the Federal Guidelines for Research Data Management, outlining the mandates that govern DMSPs, and emphasizing their significance in compliance and governance. Section 1.2 will provide a curated Basic Bibliography for DMSPs, essential for novice and seasoned researchers aiming to construct or improve their DMSPs. Finally, Section 1.3 will elucidate the Importance of DMSPs in Research, articulating how a well-structured DMSP contributes to the broader research ecosystem by enhancing credibility, facilitating collaboration, and enabling data reusability. By interlinking these areas, we aim to offer a holistic perspective on DMSPs, emphasizing their foundational role in effective Trans-Disciplinary Communication (TDC) and responsible scientific inquiry.

FEDERAL GUIDELINES FOR RESEARCH DATA MANAGEMENT

In this section, we review federal initiatives, starting with the Memorandum from the Executive Office of the President's Office of Science and Technology Policy (OSTP) and NASA's 'NASA Plan for Increasing Access to the Results of Scientific Research' (2014), which mandate open data sharing in federally funded research. This plan was initiated to comply with the OSTP directive, which required agencies with annual research and development expenditures exceeding $100 million to develop strategies for enhancing public access to federally funded research outcomes. As a significant investor in fundamental and applied research and technology development, allocating approximately $3 billion annually, NASA is committed to fostering open data sharing with research communities, academia, private industry, and the general public. While NASA has traditionally facilitated access to space and suborbital mission data for researchers worldwide, this new plan extends its open-access approach to encompass data and publications from all scientific research sponsored by the Agency.

The Science Mission directorate's document prepared by the Strategic Data Management Working Group entitled "Strategy for Data Management and Computing for Groundbreaking Science 2019-2024" (2019) outlines NASA's Science Mission Directorate (SMD) objective of advancing human knowledge through scientific exploration of the Sun, Earth, Solar System, and Universe. SMD's collaboration with the scientific community involves conducting space-based studies of the Earth and Sun, collecting data and samples from other celestial bodies, and exploring the vast expanses of the universe. The strategy emphasizes three core contexts: discovering universe secrets, searching for extraterrestrial life, and improving life on Earth. An essential capability of SMD is its ability to collect, store, manage, analyze, and disseminate vast amounts of data for scientists, international partners, and industry to advance scientific knowledge. The document highlights that a significant fraction of scientific research now relies on archived data, exceeding that based on new mission data. With SMD's data archives currently holding over 100 Petabytes of data and projected data rates for upcoming missions expected to exceed 100 PB per year, the strategy emphasizes the challenges and opportunities for data management, curation,

access, analysis, and computing.

The next federal initiative that the authors deem critically necessary is the National Institutes of Health (NIH) 'Data Management and Sharing (DMS) policy' (NIH, 2020a). Effective January 25, 2023, this policy aims to promote the sharing of scientific data. By encouraging data sharing, the policy seeks to accelerate biomedical research progress through result validation, accessibility to valuable datasets, and data reuse for future studies. Investigators and institutions must plan and allocate data management and sharing budgets to adhere to this policy. When applying for funding, each awarding component must also submit a Data Management and Sharing Plan (or plans in case of collaborative groups) for review and subsequently comply with the approved plan. This means that if two universities collaborate, each has to have its own DMSP and must be integrated with a Data Sharing Policy. The policy emphasizes the significance of sound data management practices and underscores the expectation for maximizing appropriate data sharing from NIH-funded or conducted research, with justifiable exceptions or limitations. It encompasses all research funded or conducted by NIH that yields scientific data.

Additionally, the authors considered it essential to discuss the 'Data Management for NSF SBE Directorate Proposals and Awards' (NSF SBE, 2018), which provides an overview of the Data Management Plan (DMP) requirements for researchers within the Social, Behavioral, and Economic (SBE) Sciences. The DMP, a supplementary document, must be concise, limited to two pages, and address essential aspects. These include detailing the data generated during the research, outlining the data management plan during and after the project's completion, and specifying whether data and (or) metadata will be made available to others, with reasons if they are not accessible. Researchers are encouraged to refer to workshop reports and NSF's comprehensive Public Access Plan for guidance on data management in the SBE sciences. The definition of "data" encompasses factual material required for validating research findings, comprising original data and associated "metadata." The data management plan's evaluation is integral to the proposal, with peer reviewers assessing its adequacy and adherence to best practices in the relevant research area, ensuring appropriate handling of generated data.

BASIC BIBLIOGRAPHY

The Association of American Universities (AAU) and the Association of Public and Land-grant Universities (APLU) have jointly spearheaded initiatives to improve public access to data from federally funded research projects. They have been awarded a grant by the National Science Foundation (NSF # 1939279) to support the "Accelerating Public Access to Research Data" Initiative (Smith et al., 2021). In 2020, AAU and APLU organized an Acceleration Conference, bringing representatives from various universities to discuss and develop strategies for ensuring adequate public access to high-quality research data. Additionally, they facilitated two national Summits aimed at assisting universities in creating robust systems to support data sharing. The development of the Guide was influenced by insights gathered from 261 campus representatives representing 111 institutions, federal agency representatives, and other essential stakeholders. The Guide's primary purpose is to assist institutions in establishing and promoting systems that facilitate research data sharing. It offers valuable advice on actions that can be taken to enhance research data accessibility on campuses. Furthermore,

it provides information about the necessary infrastructure and support that may be required to facilitate data access. The resultant Guide is a compendium of best practices and recommendations gathered from stakeholders, aiming to enhance data access mechanisms at institutional levels.

IMPORTANCE

DMSPs play a vital role in research by ensuring efficient, transparent, and responsible handling of research data. These plans promote data transparency, enabling other researchers to validate findings and encourage data reuse and collaboration for future studies. Additionally, DMSPs address ethical considerations, protecting participants' rights and privacy. Researchers increase their chances of obtaining funding and garner institutional support by complying with funding agency requirements. Furthermore, DMSPs facilitate research reproducibility and long-term data preservation, bolstering public trust in scientific findings. Moreover, these plans help researchers proactively address potential data challenges, such as data loss and sharing obstacles, thereby enhancing the overall integrity of the research process.

METHODOLOGY

The present study employed a targeted literature review to discern sponsor-specific policies and guidelines for DMSPs. It must be noted that our objective was not to catalog these policies exhaustively but rather to provide a critical analysis of existing frameworks. To achieve this, we consulted a wide range of online resources and compiled a corpus consisting of 13 documents emanating from 9 different sponsors (DOD, 2019; DOE, n.d.-a, n.d.-b; FASEB, 2021; NIH, 2020b, 2020a; NSF, 2020; NSF ADC, 2011; NSF OCE, 2011; Sloan, 2023). The National Science Foundation (NSF) had distinct templates for its diverse directorates. Our analysis identified 52 unique elements across these templates, which were subsequently organized into six major categories for further discussion:

MAJOR CATEGORIES AND ELEMENTS

The categories we have identified as integral components of a Data Management and Sharing Plan (DMSP) include:

a) Roles and responsibilities

b) Expected data

c) Data Types, Formats, and Dissemination

d) Data Storage, Retention, and Preservation of Access

e) Standards and Compliance

f) Additional Resources and Miscellaneous Considerations

a) Roles and responsibilities

Principal Investigator (PI): Responsible for the DMSP's overall vision, design, and integrity.

Co-investigators and Research Team: Contribute to planning, data collection, analysis, and dissemination.

Data Managers and Curators: Organizing, maintaining, and preserving data per established protocols and standards.

Project Manager: Oversees alignment with the DMSP's timelines, budgets, and specific objectives.

Institutional Review Board (IRB): Ensures ethical considerations are thoroughly addressed, safeguarding participants' rights and privacy.

Funding Agencies: Provide oversight and financial backing for the project. Collaborators and Data Contributors: Enrich the research by contributing unique expertise, perspectives, or data.

Compliance Administrator: Ensures adherence to legal and regulatory requirements.

b) Expected Data

This category defines what is considered data within the scope of the project. It encapsulates all empirical materials gathered or generated for the research, such as observations, measurements, interviews, surveys, and experimental results. A clear definition enhances alignment and consistency across the research team.

c) Data Types, Formats, and Dissemination

Data Types: This section delineates various possible forms of data, including categorical, numerical, textual, or visual.

Preferred Formats: Specifies the preferred formats to ensure data consistency and compatibility.

Dissemination Strategies: Outlines how the data will be accessible to researchers, policymakers, and the general public.

d) Data Storage, Retention, and Preservation of Access

Storage involves selecting secure, easily accessible, and robust storage solutions. Retention: Policy for how long the data will be retained, considering legal, ethical, and practical factors.

Preservation of Access: Ensuring data remains accessible and usable over time, including potential migration to new formats or platforms.

e) Standards and Compliance

ISO, Dublin Core, and others: Adoption of recognized international standards for data management, metadata, quality assurance, and other relevant aspects, demonstrating commitment to best practices.

f) Additional Resources and Miscellaneous Considerations

Supplementary Frameworks: This could encompass logic models, theories of change, or other conceptual frameworks that guide the DMSP's implementation. These may provide theoretical underpinnings, methodologies, or tools that enhance the project's transparency, collaboration, and innovation.

EXAMPLE OF A DMSP

The Data Management and Sharing Plan (DMSP) presented herein provides a comprehensive framework for the data collection and management strategies associated with the "Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D)" project created by the authors (Yañez León et al., 2023). This DMSP is an instructive exemplar at the New Jersey Institute of Technology, offering researchers a systematic guide for formulating their DMSPs. By carefully analyzing this well-conceived plan, scholars may garner valuable insights into efficacious data collection techniques, rigorous data management protocols, and innovative strategies for engendering substantive dialogue in Trans-Disciplinary Communication (See Annex A)[3].

DISCUSSION

The multifaceted Data Management and Sharing Plan (DMSP) for the "Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D)" project serves as a touchstone for researchers traversing the complex landscape of data governance and interdisciplinary collaboration. The plan's comprehensiveness is particularly salient, encompassing six significant categories: roles and responsibilities, expected data, data types and formats, data storage and retention, standards and compliance, and

3 You can read the full DMSP here: https://doi.org/10.48321/D16S7D

related resources. Each category structures the framework and sets the stage for rigorous methodology and ethical considerations.

CHALLENGES AND BARRIERS TO EFFECTIVE IMPLEMENTATION

As the Data Management and Sharing Plan (DMSP) aims to be an all-encompassing manual, it encounters various obstacles that can impede its successful execution. The diverse requirements of different stakeholders, particularly in a setting that involves multiple disciplines, may lead to goal divergence or even discord.

Additionally, the swift technological advancements can render existing DMSP guidelines obsolete, making regular modifications indispensable.

Although insufficient time, financial limitations, and a lack of specialized knowledge can act as roadblocks to effective and comprehensive implementation, it is crucial to surmount these challenges in light of the numerous benefits offered by data sharing and transparency. As elaborated in Section 5.2, the advantages of data sharing and transparency extend well beyond the scope of an individual research project.

BENEFITS OF DATA SHARING AND TRANSPARENCY

Data sharing and transparency have myriad benefits beyond the individual research project. By making data accessible to other researchers and the public, the research's impact and utility are maximized. This open approach to science fosters collaboration, encourages peer review, and accelerates the pace of discovery. It is particularly essential in trans-disciplinary research, where complex problems often require collaborative approaches that draw on various domains of expertise.

ETHICAL IMPLICATIONS OF DATA SHARING

Data sharing is not without ethical concerns. While open access to data supports the democratization of knowledge, it also poses risks, particularly regarding the privacy and confidentiality of participants. This makes the role of the Institutional Review Board (IRB) even more critical, as they are charged with ensuring ethical considerations are met. Moreover, the moral landscape extends to data ownership and the appropriate crediting of contributors when shared data are re-analyzed or repurposed.

LIMITATIONS AND FUTURE DIRECTIONS

The DMSP is not without its limitations. While it serves as an excellent guide, the continual evolution of data management standards and sponsor requirements calls for its frequent updating. Additionally, the need for a deeper dive into specific protocols for data storage, particularly addressing concerns about data security and the long-term preservation of access, is evident. Future work must focus on incorporating evolving international standards and addressing these gaps to make the DMSP an even more robust instrument.

The DMSP for the TDC3D project serves as a comprehensive framework guiding researchers through the intricate terrain of data governance and interdisciplinary collaboration. The plan is notably thorough, covering six primary areas: roles and responsibilities, expected data, data types and formats, data storage and retention, standards and compliance, and related resources.

However, the DMSP faces many challenges that could hinder its effective execution. The divergent needs of stakeholders in a multi-disciplinary setting can lead to conflict or misalignment of objectives. Rapid

technological advancements necessitate the constant updating of DMSP guidelines, while limitations in time, budget, and specialized expertise can serve as barriers to comprehensive implementation.

In contrast, data sharing and transparency offer numerous benefits, extending the reach and impact of the research beyond its initial scope. This open-science approach promotes interdisciplinary collaboration, supports peer review, and accelerates the pace of scientific discovery. These benefits are particularly salient in trans-disciplinary research, where resolving complex issues often necessitates input from diverse areas of expertise.

Ethical considerations also weigh heavily in the domain of data sharing. While openness advances the democratization of knowledge, it raises concerns about participant privacy and data confidentiality. This amplifies the role of Institutional Review Boards (IRBs) in ensuring ethical compliance.

Lastly, the DMSP has its limitations and areas for future exploration. Data management standards' continual evolution and sponsor requirements call for periodic updates. Specific protocols for data storage, addressing concerns over data security and long-term accessibility, require more in-depth examination. Future iterations of the DMSP must aim to incorporate these evolving standards and fill existing gaps, enhancing its utility as a robust guide for research governance.

CONCLUSION

In conclusion, the Data Management and Sharing Plan (DMSP) for the 'Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D)' project stands as a paradigm, serving as a model for a nuanced, comprehensive approach to data management within interdisciplinary research settings. It intends to integrate students and societal stakeholders into Trans-Disciplinary Communication (TDC). Not only does its intricately designed framework provide robust guidance through all phases of research, from initial conceptualization to the final stage of disseminating findings, but it has also demonstrated tangible benefits in the field. Specifically, the application of this DMSP facilitated the publication of over 14 scholarly papers within a six-month timeframe, thereby underscoring its practical utility in accelerating academic contributions.

The DMSP achieves this by establishing a unified set of protocols and a shared vocabulary, enabling streamlined communication across disciplines. While the plan does require ongoing adaptation to meet evolving parameters and academic standards, it nonetheless offers a substantive guide for fostering meaningful dialogues and collaborations in Trans-Disciplinary Communication. Its adaptability is one of its core strengths, allowing it to stay relevant and practical. As interdisciplinary research expands, tools like this DMSP will prove indispensable in harmonizing disparate elements. This enhances the pace and quality of scholarly output, thereby directly contributing to innovation, academic integrity, and broader societal impact. The authors began by aligning the rationale, answering, "Why are we doing this?" Subsequent conversations led to defining the objectives, addressing "What are we going to do?" Finally, the methods emerged in practice and remain in constant flux as collaboration continues, clarifying the 'How'.

ACKNOWLEDGMENTS

Special thanks to Cynthia Shafer, Sandy Hanyun Chang, and Katie Lipuma for their unconditional support.

Peer-Editor: Marcos Cabobianco; Head of practical work (History). Universidad de

Buenos Aires, Argentina.

Non-anonymous peer-reviewer: Edgar Meritano, Department of Sciences and Arts for Design, Research and Knowledge. ``*Universidad Autónoma Metropolitana*``.

Beta-Readers: Agustina Cabrera, Faculty of Architecture, Design and Urban Planning, ``*Universidad de Buenos Aires*``, Argentina.

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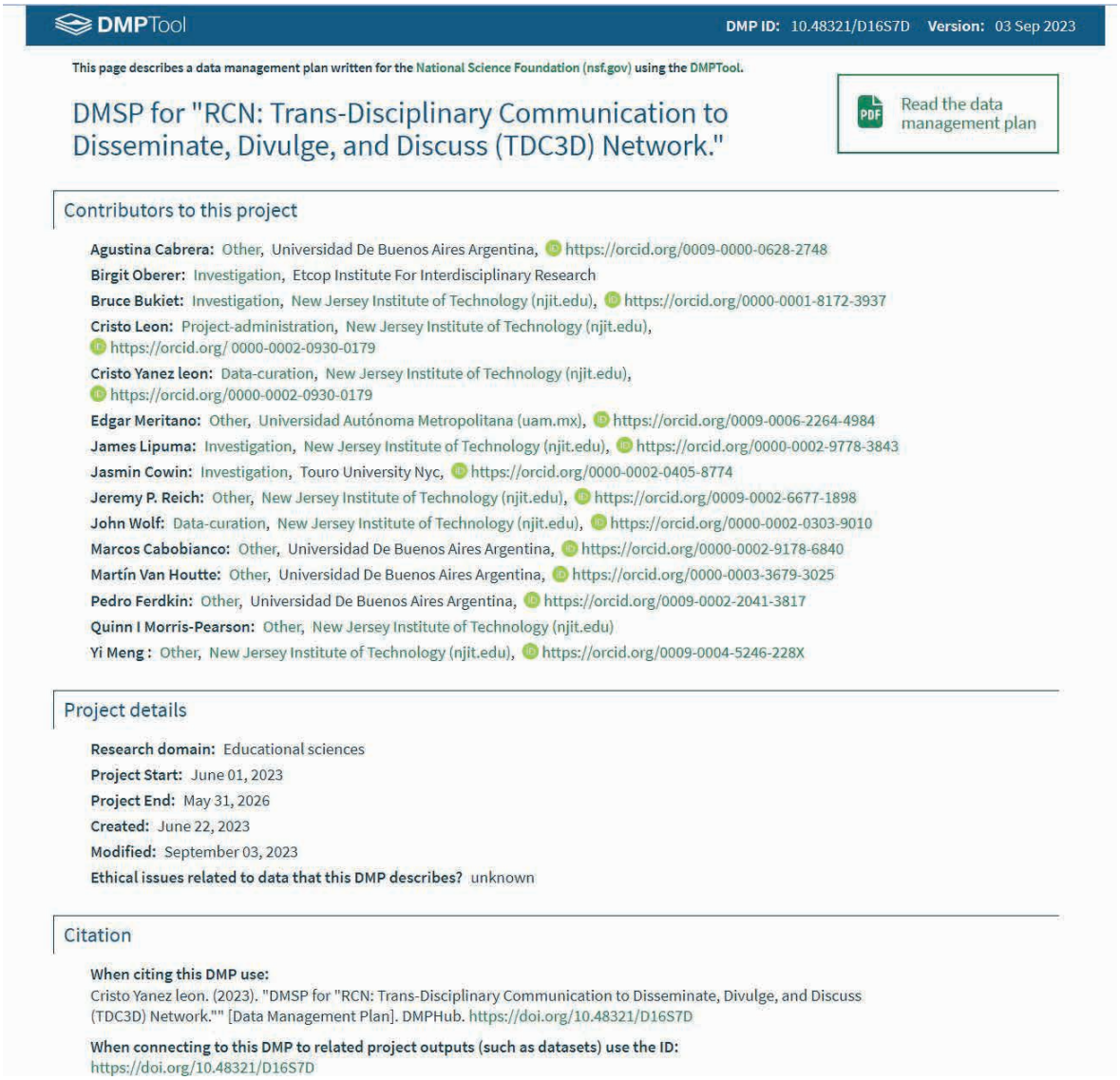
ANNEX A



DMPTool DMP ID: 10.48321/D16S7D Version: 03 Sep 2023

This page describes a data management plan written for the National Science Foundation (nsf.gov) using the DMPTool.

DMSP for "RCN: Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D) Network."

Read the data management plan

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Project details

Research domain: Educational sciences
Project Start: June 01, 2023
Project End: May 31, 2026
Created: June 22, 2023
Modified: September 03, 2023
Ethical issues related to data that this DMP describes? unknown

Citation

When citing this DMP use:
Cristo Yanez leon. (2023). "DMSP for "RCN: Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D) Network."" [Data Management Plan]. DMPHub. https://doi.org/10.48321/D16S7D

When connecting to this DMP to related project outputs (such as datasets) use the ID:
https://doi.org/10.48321/D16S7D

Note. Recovered from "DMSP for 'RCN: Trans-Disciplinary Communication to Disseminate, Divulge, and Discuss (TDC3D) Network,'" by C. E. Yañez León, J. Lipuma, B. Bukiet, J. Wolf, J. Cowin, B. Oberer, M. Cabobianco, & P. Ferdkin, 2023 (CLDM_Dv; Version 1) [DMSP]. DMPTool is a service of the California Digital Library; /Research/Collaboration & Convergence. https://doi.org/10.48321/D16S7D. Licensed under CC BY-NC-ND 4.0 International.