West Virginia Structural Health Monitoring Project

Dataset and Contact Information

Please provide as much of the the following information as possible:

1. **Name of the project;**
2. **Grant number;**
3. **Name of the person submitting this DMP;**
4. **ORCiD of the person submitting this DMP (need an ORCID? Register here: https://orcid.org/);**
5. **Email and phone number of the person submitting this DMP;**
6. **Name of the organization for which the person submitting this DMP is working;**
7. **Email and phone number for the organization;**
8. **Link to organization or project website, if applicable; and,**
9. **Date the DMP was written.**

1. West Virginia Structural Health Monitoring Project
2. SMARTFY22N1P1G59
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8. transportation.wv.gov
9. 12/15/2023

Data Description

Please provide as much information as possible:

1. **Provide a description of the data that you will be gathering in the course of your project or data from a third party that you will re-use, if any;**
    1. **If there will be no data collected or re-used from another source, state that this is case;**
2. **Address the expected nature, scope, and scale of the data that will be collected, as best as you can at this stage;**
3. **As best as you can, describe the characteristics of the data, their relationship to other data, and provide sufficient detail so that reviewers will understand any disclosure risks that may apply;**
    1. **If data might be sensitive, please describe how you will protect privacy and security, if you know that now;**
    2. **You may need to update your DMP later to add more detail;**
4. **Discuss the expected value of the data over the long-term.**

- The West Virginia Department of Transportation (WVDOT) Structural Health Monitoring (SHM) Data Management Plan (DMP) provides a framework for collecting, processing, managing, storing, and archiving data throughout the Stage 1 USDOT SMART grant period. The DMP is a living document and will be updated as needed. The SHM project includes deploying a variety of sensor types on East Huntington Bridge, collecting the data through a data management platform, and analyzing the collected

data for structural health monitoring. East Huntington Bridge is an approximately 900-foot cable-stayed bridge which carries WV106 over the Ohio River in western West Virginia. The data collected through this project and included in the DMP includes the bridge sensor data and may include the following:

- Accelerometer Sensor:
  - Acceleration amplitude (X)
  - Acceleration amplitude (Y)
  - Acceleration amplitude (Z)
- Temperature
  - Tiltmeter Sensor:
    - Phi Angle
    - Theta Angle
    - Temperature
    - Acceleration amplitude
    - Angle Velocity Threshold
  - Displacement Sensor:
    - Joint and bearing movements
  - Crackmeter Sensor:
    - Crack movement
    - Probe temperature
  - Weather Station:
    - Wind speed
    - Wind direction
    - Ambient temperature

Sensors will be connected to a data management platform that will collect and store the sensor data during the project.

Data Characteristics:
Datasets will be cataloged in the data management system during the active phase of the project. Data will be periodically downloaded from the system and stored as CSV files.
Data Sensitivity:
Collected data will not include personally identifiable information (PII).
Relationship to other data:
Data collected through this project may be used in conjunction with other bridge engineering calculations or asset management programs to support the operations and maintenance of the bridge lifecycle. The primary focus of this project is to monitor and analyze the collected sensor data. Project extensions and relationships to other data may be further explored throughout the project and in future phases.

Long Term Value:
The data collected is expected to provide significant long-term value by:

- Informing WVDOT of best practices and benefits of structural health monitoring.
- Enabling further innovation in structural health monitoring.

Data Format and Metadata Standards Employed

Please provide as much information as you can:

1. **Describe the anticipated file formats of your data and related files;**
2. **To the maximum extent practicable, your DMP should address how you will use platform-independent and non-proprietary formats to ensure maximum utility of the data in the future;**
    1. **If you are unable to use platform-independent and non-proprietary formats, you should specify the standards and formats that will be used and the rationale for**

using those standards and formats.

3. **Identify the metadata standards you will use to describe the data.**
    1. **At least one metadata file should be a DCAT-US v1.1 (https://resources.data.gov/resources/dcat-us/) .JSON file, the federal standard for data search and discovery.**

Introduction:
The SHM project includes deploying a variety of sensor types on East Huntington Bridge, collecting the data through a data management platform, and analyzing the collected data for structural health monitoring. East Huntington Bridge is an approximately 900-foot cable-stayed bridge that carries WV106 over the Ohio River in western West Virginia. The data collected through this project and included in the DMP includes the bridge sensor data and may include the following.

Anticipated File Formats:
The project will use machine-readable, platform-independent, non-proprietary, and widely adopted file formats wherever feasible to maximize the long-term utility and accessibility of the data. Although unexpected, if proprietary formats or software must be used, the project team will undertake an evaluation to ensure compatibility and accessibility as much as is feasible within the scope of the project. The following file formats are expected:
CSV: For tabular data that requires compatibility with basic tools like spreadsheets.

- JSON: For metadata and other structured data.

The project team's rationale for file format choices includes but is not limited to the following:

- Non-proprietary and Open Standards: Formats like CSV and JSON support platform independence and broad compatibility.
- Longevity: Open standards reduce reliance on specific software or platforms, ensuring long-term usability.

Metadata Standards:
The dataset features five main folders: accelerometer, crackmeter, displacement, tiltmeter, and weather station. These folders contain all available data corresponding to the type of sensor. The accelerometer dataset features high-resolution acceleration data for all recorded events in the sampling window. All sample points are available for each accelerometer event. All other datasets provide only the primary measurement for that event along with data related to that event. Recorded events are identified by their event ID, abbreviated '_id'. Each sensor has its own unique sensor ID or extended unique identified, abbreviated 'eui'. Datatypes provided for each sensor are described in the corresponding ReadMe files. All times are in UTC. West Virginia observes Daylight Savings time.

Access Policies

In general, data from DOT-funded projects must be made publicly accessible. Exceptions to this policy are: data that contain personally identifiable information (PII) that cannot be anonymized; confidential business information; or classified information. Protecting research participants and guarding against the disclosure of identities and/or confidential business information is an essential norm in scientific research. Your DMP should address these issues and outline the efforts you will take to provide informed consent statements to participants, the steps you will take the protect privacy and confidentiality prior to archiving your data, and any additional concerns. In general, in matters of human subject research, your DMP should describe how your informed consent forms will permit sharing with the research community and whether additional steps, such as an Institutional Review Board (IRB), may be used to protect privacy and confidentiality. Additionally, when working with, or conducting research

that includes Indigenous populations or Tribal communities, researcher will adhere to the CARE Principles for Indigenous Data Governance https://www.gida-global.org/care and make an explicit statement to that effect in this portion of the DMP.

Please provide as much information as possible:

1. **Describe any sensitive data that may be collected or used;**
2. **Describe how you will protect PII or other sensitive data, including IRB review, application of CARE Principles guidelines, or other ethical norms and practices;**
    1. **If you will not be able to deidentify the data in a manner that protects privacy and confidentiality while maintaining the utility of the dataset, you should describe the necessary restrictions on access and use;**
3. **Describe any access restrictions that may apply to your data;**
4. **If necessary, describe any division of responsibilities for stewarding and protecting the data among Principal Investigators or other project staff.**

Sensitive Data:
The bridge sensor data collected by the project team does not represent a particular person or entity and is not expected to include any data that contains sensitive information, such as Personally Identifiable Information (PII), confidential business information (CBI), or restricted data. If any data collected is determined to be sensitive, the project team will take necessary measures to either restrict public access or anonymize the data to a degree that balances confidentiality with the utility of the dataset. The decision-making process behind the level of accessibility for each dataset will be documented and will follow the policies of the WVDOT, where applicable and feasible.

Data Access Controls
Although it does not contain PII, the project team intends to utilize a variety of access control, authentication, and verification techniques to ensure that only appropriate staff access have raw data. Throughout the research phase of the project, data will be securely stored on its data management platform and will conform to the following data access control techniques:

- Role-Based Access Control: This is a data security model that regulates access to raw data based on defined roles in the organizational structure. It ensures that staff only have access to data relevant to their responsibilities.
- Least Privilege Access Control: This data security method ensures that staff have the minimum level of access necessary to perform their tasks and responsibilities.
- Request / Approval Model: In this circumstance, a given staff member submits a data access form to the data owner. The data owner will then approve or deny authorized access to the raw data being stored.

Re-use, Redistribution, and Derivatives Products Policies

Recipients are reminded:

1. **Data, as a collection of facts, cannot be copyrighted under US copyright law;**
2. **Projects carried out under a US DOT SMART Grants is federally funded; therefore, as stated in grant language:**
    1. **Recipients must comply with the US DOT Public Access Plan, meaning, among other requirements, project data must be shared with the public, either by the researchers or by US DOT;**
    2. **That by accepting US DOT funding through this grant, recipients have granted to US DOT a comprehensive non-exclusive, paid-up, royalty-free copyright license for all project outputs (publications, datasets, software, code, etc.). This includes all rights under copyright, including, but not limited to the rights to copy, distribute, prepare derivative works, and the right to display and/or perform a work in public; and,**

3. **In accordance with Chapter 18 of Title 35 of the United States Code, also known as the Bayh-Dole Act, where grant recipients elect to retain title to any invention developed under this grant, US DOT retains a statutory nonexclusive, nontransferrable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any such invention throughout the world.**

Please provide as much information as possible:

1. **Describe who will hold the intellectual property rights for the data created or used during the project;**
2. **Describe whether you will transfer those rights to a data archive, if appropriate;**
3. **Identify whether any licenses apply to the data;**
    1. **If you will be enforcing terms of use or a requirement for data citation through a license, indicate as much in your DMP;**
4. **Describe any other legal requirements that might need to be addressed.**

Intellectual Property Rights
Intellectual Property Rights (IPR) for the data collected and used throughout the duration of West Virginia Structural Health Monitoring Project will be held by WVDOT. WVDOT intends to use data sharing and licensing agreements for entities wanting to analyze the data. The purpose of the agreement is to establish ownership of usage rights, maintain compliance, and ensure data security. In addition, access controls will be used to specify who may use each resource and how they may use it.
Compliance with USDOT
By receiving USDOT funding, this project has granted the USDOT a comprehensive non-exclusive, paid-up, royalty-free copyright license for all project outputs, including but not limited to publications, datasets, software, code, and other derivate products. This includes all rights under copyright, including but not limited to the rights to copy, distribute, prepare derivative works, and the right to display and/or perform a work in public. In accordance with Chapter 18 of Title 35 of the United States Code, also known as the Bayh-Dole Act, if this project elects to retain title to any invention developed under this grant, USDOT retains a statutory nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any such invention throughout the world. In compliance with the USDOT Public Access Plan, this project will transfer data to a public data repository, ensuring the data and project outputs are accessible to the public
and other stakeholders.

Archiving and Preservation Plan

Please provide as much information as possible:

1. **State where you intend to archive your data and why you have chosen that particular option;**
2. **Provide a link to the repository;**
3. **You must describe the dataset that is being archived with a minimum amount of metadata that ensures its discoverability;**
    1. **Whatever archive option you choose, that archive should support the capture and provision of the US Federal Government DCAT-US Metadata Schema https://resources.data.gov/resources/dcat-us/**
4. **In addition, the archive you choose should support the creation and maintenance of persistent identifiers (e.g., DOIs, handles, etc.) and must provide for maintenance of those identifiers throughout the preservation lifecycle of the data;**
5. **Your plan should address how your archiving and preservation choices meet these requirements.**

Upon completion of the project, the project team will place the final data repository in ROSA P. Additionally, ROSA P will provide the DOI for the dataset. This will be compliant with USDOT standards and will provide metadata conformant with DCAT-US v1.1 metadata schema.

1. Data Archive Location: The final dataset will be placed into a data repository conformant with U.S. DOT standards as outlined at https://ntl.bts.gov/ntl/public- access/data-repositories-conformant-dot-public-access-plan. These repositories provide persistent identifiers to their published data and supports the capture and provision of the DCAT-US Metadata Schema.

a. Digital Object Identifiers (DOI) will be assigned to each dataset to facilitate its reuse and distribution and enhance its long-term discoverability.
b. The data will be accessible via DOI-enhanced URI.

2. Metadata: The archived datasets will include metadata to ensure they are searchable, understandable, and reusable by researchers and stakeholders. The metadata will align with the US Federal Government DCAT-US Metadata v.1.1 Schema.
a. The key examples of metadata to be included are title, creator, description, time, location, keywords, and contact information, etc.

Planned Research Outputs

Dataset - "West Virginia Structural Health Monitoring Project"

The dataset features five main folders: accelerometer, crackmeter, displacement, tiltmeter, and weather station. These folders contain all available data corresponding to the type of sensor. The accelerometer dataset features high-resolution acceleration data for all recorded events in the sampling window. All sample points are available for each accelerometer event. All other datasets provide only the primary measurement for that event along with data related to that event. Recorded events are identified by their event ID, abbreviated '_id'. Each sensor has its own unique sensor ID or extended unique identified, abbreviated 'eui'. Datatypes provided for each sensor are described in the corresponding ReadMe files. All times are in UTC. West Virginia observes Daylight Savings time.

Planned research output details

Title	Type	Anticipated release date	Initial access level	Intended repository(ies)	Anticipated file size	License	Metadata standard(s)	May contain sensitive data?	May contain PII?
West Virginia Structural Health Monitoring Project	Dataset	2025-04-14	Open	ROSA P		Creative Commons Zero v1.0 Universal	DCAT-US	No	No