Data Management Plan for the National UTC
National Center for Transportation Infrastructure Durability & Life-Extension (TriDurLE)

Date: December 18, 2019

The National Center for Transportation Infrastructure Durability & Life-Extension (TriDurLE) led by Washington State University (WSU) is one of seven National University Transportation Centers (UTCs) sponsored by the U.S. Department of Transportation (DOT). TriDurLE was selected in the 2019 nationwide competition under the FAST Act. We serve as the only National UTC with a focus on the USDOT strategic priority of "***Improving the Durability and Extending the Life of Transportation Infrastructure***." The TriDurLE consortium includes:

- Alabama A&M University
- Case Western Research University
- Florida Atlantic University
- Missouri University of Science and Technology
- South Dakota State University
- Tennessee State University
- Texas A&M University
- University of Colorado Denver
- University of Mississippi
- University of Utah

Each consortium member of TriDurLE brings certain unique strengths and credentials to this collaborative team and we collectively offer multidisciplinary programs engaged in innovative research, education, and technology transfer.

This data management plan (DMP) is designed to facilitate the best practices of data documentation and promote the sharing of research results and experimental data across the broad spectrum of stakeholders of this National University Transportation Center (UTC) grant. During the implementation of this grant, we will collect and generate a variety of data from, but not limited to, laboratory testing, field investigations, remote sensing, climate changes, infrastructure performance, traffic conditions, societal/economic analysis, numerical analyses, etc.

This DMP will cover all data acquired by TriDurLE activities and may be updated as necessary, to accommodate unanticipated data needs or data types and related challenges that arise during the course of this multi-year grant. Individual project Principal Investigators (PIs), in communication with the Center Director or other Site Directors, will ensure adherence to this DMP and will suggest changes to it if deemed necessary. This plan will describe the normal practices at WSU (or the appropriate Member University of TriDurLE) to ensure both "access to data" and "data sharing" as defined in the National Science Foundation's "Advice to PIs on Data Management Plans" and follow the appropriate university policies.

Types of Data
This grant will produce a variety of data, such as:

- Experimental and modeling data
- Survey data
- Photography and videography
- Software
- Drawings
- Guidelines, examples, handouts, brochures, and posters
- Lesson plans, syllabi and/or course materials

TriDurLE activities will produce several types of data related to research, leadership, educational activities, diversity and workforce development, and technology transfer. Much of the data will be accessible from the TriDurLE website (https://tridurle.wsu.edu/) by the public at large. Nonetheless, very large datasets or sensitive data (in terms of privacy and intellectual properties - IP) may be only accessible to authorized personnel via secured (password protected) ftp site, or may not be made accessible to the public at all under some situations.

Data collected or generated from *Research* may include, but are not limited to:
- Manual collection of laboratory or field data
- Automated collection of laboratory or field data
- Algorithms and software (original and commercial source code)
- Performance metrics of TriDurLE research, such as: number of peer-reviewed publications and their citations, conferences, and presentations; media coverage of TriDurLE and TriDurLE projects on internet; number of implemented strategies, products, patent applications, or techniques

Research data will be managed under the specific management plans for each associated research project. The TriDurLE research results will also be incorporated into peer-reviewed publications, and presented at professional or academic conferences, workshops, etc. Data of this type will also be shared with USDOT OST-R in the annual reports. Students will be educated on how to maintain proper logbooks and data management during their research experience. As the end of the research project, they are required to document all their work and submit their logbooks plus all electronic files/data used to their faculty mentor.

In light of the multi-institutional nature of this Center, each consortium member university is responsible for data storage and archiving commensurate with the established data management procedures and file specifications of that institution. Data management and enforcement of data management expectations among Center members will be coordinated through this general DMP, email correspondence, and subordinate Data Security Plans, if necessary. In addition to the dissemination of relevant technical data and findings via journals and conferences, PI of each TriDurLE research project is responsible for collecting, storing, retaining, and sharing the data from the research, education, or outreach activities on his or her project. At the completion of each research project, the PI will be required to upload and store all the processed data electronically, on a server managed by WSU. The information technology (IT) staff at WSU will facilitate the storage and archiving of data at the discretion and direction of the Center Director and the requirements set forth within the scope of work of TriDurLE.

Each Site Director of TriDurLE is responsible for managing the project PIs at his or her site in ensuring the adherence to this DMP, i.e., all the necessary data are collected, stored, retained, and accessible. Should any of the project PI or co-PI leaves the institution, the Site Director will remind this person to follow the best practices outlined in this DMP, such as providing copies of the data to the remaining PI or Center Director along with documents that describe what data have been collected, how the data are collected, where and in what format the data are stored, and how the data can be accessed.

Data collected or generated from *Leadership* may include, but are not limited to:
- Performance metrics of TriDurLE leadership, such as: number of students funded to conduct research and to attend conferences; number of junior faculty receiving seed fund awards; number of online seminars offered to future leaders; states in which research or implementation is active; significant rewards received by researchers; researchers serving expert panels for agencies/programs, organizing conferences, and selected for major professional leadership positions
- Documentation of leadership activities and achievements by TriDurLE researchers and staff

Data collected or generated from *Education, Diversity and Workforce Development* may include, but are not limited to:

- Educational materials to support student research, syllabi and course modules in TriDurLE-related topics, K-12 outreach, educational software, recordings of seminars and other professional events, etc.
- Continuing education, lecture notes, and other curriculum or training materials
- Performance metrics of TriDurLE education, such as: number of attendees in K-12 programs; transportation related courses offered by faculty affiliated with TriDurLE, number of undergraduate and graduate students participating in TriDurLE activities; number of transportation related degree and non-degree programs
- Performance metrics of TriDurLE diversity, such as: number of female, minority or disabled students in TriDurLE research; demographics of TriDurLE event attendees.
- Performance metrics of TriDurLE workforce development, such as: number of attendees at training sessions, webinars, career-building activities, or online courses; hours of technical assistance offered to agencies through project meetings and training workshops;

Data collected or generated from *Technology Transfer (T2)* may include, but are not limited to:

- Technical documentation (journal papers, conference papers, reports, etc.) written by TriDurLE researchers, students, and collaborators
- Instructional videos (seminars/training sessions, webinars, featured speakers, and other events)
- Social media posts, image data, animations or videos that broaden the impacts of TriDurLE activities
- Quarterly e-newsletters
- Annual progress reports
- Performance metrics of TriDurLE T2, such as: number of inventions, patent applications, technologies etc. resulting from TriDurLE research activities; presentations given at professional and academic meetings; peer-reviewed publications; number of attendees at TriDurLE T2 events; number of stakeholders engaged in TriDurLE activities; number of partnerships formed; number of adoptions of TriDurLE research outputs; benefits to industry or society from TriDurLE activities

Other types of data may include assessment results for the TriDurLE research, education, diversity, workforce development, and T2 activities.

Data Standards and Formats
As commercially available packages (EXCEL, MATLAB, ArcGIS, SPSS, SQL database, etc.) will be used to perform data analysis, these packages are industry standard and their data formats are not expected to become obsolete in the foreseeable future. As such, we will not plan to define any standards.

All data will be stored in laboratory notebooks and/or electronically. If data are only available electronically, data should be cross-referenced in laboratory notebooks with a data dictionary including description of each data element, date, sample name, and project title. Research data will be captured and kept in databases or flat file format from raw laboratory notes or as ASCII, TIFF, OIB files from experimental analysis. Plots will be captured using commercial mathematical packages, e.g. EXCEL (.csv or.xlsx) MATLAB, Mathematica, ANSYS, ArcGIS, SPSS, SQL database, ORIGIN, etc., and images will be saved in standard file formats (PDF, TIFF, JPEG, etc.). Software will be written in C, C++, MATLAB, EXCEL, or another readily-available programming language or platform. Presentations, seminar materials, and instructional documentation will be created and saved in Microsoft PowerPoint, PDF, or Word formats. The data will be submitted to conferences and journals in WORD or PDF format manuscripts. The assessment or diversity data will be managed to follow the guidance of the Institutional Review Board (IRB) for WSU, which is "responsible for the review and approval of all research activities

involving human subjects". The research activities involving human subjects will seek approval by the IRB prior to initiating any portion of the activity.

Policies for access and sharing and provisions for appropriate protections
The data received from this UTC grant will not include personal information and will be used solely for analysis and comparison. When raw data is received, it will need to be further filtered and sorted into readable format for analysis. Each TriDurLE project PI will use one or more of the following mechanisms to disseminate the research data: peer-reviewed publications, journal papers, conference proceedings, thesis or dissertation, professional meetings, academic conferences or workshops, technical talks, industry visits, webinars, and social media.

At the completion of each research project, the project PI will be asked to make the processed data available through the WSU Research Exchange (https://research.wsulibs.wsu.edu:8443/xmlui/), which enables data access by the general public. Sharing of original data files can also be provided by uploading the files to the journal websites so that interested readers will have the opportunity to download a complete set of data. The TriDurLE researchers will decide individually whether they want to share their raw or processed data in the public domain. Data that are the subject of ongoing analysis for publication will generally not be made available except under special circumstances such as collaborative arrangements. For unpublished data beyond ongoing analysis for publication, as long as they do not contain any information related to privacy or patent application, they will be either mailed or emailed out upon request.

The project PIs and their institutions own the research data they generate. Intellectual Property (IP) developed includes, but is not limited to inventions, patent applications, patents, mask works, software, or other legally protectable information, will be owned by the participating party or parties whose employees or agents make or generate the IP. All rights to IP will be maintained by the parties who are responsible for its creation and will be subject to each organization's policies of rights assignation. Therefore, ownership may reside with a single entity or multiple parties. In the event that program IP is jointly held, each contributing organization will have equal rights to the technology, unless otherwise agreed upon and such an agreement is memorialized in writing. Background IP, program IP and other proprietary or confidential information disclosed by any participant to another will be treated as confidential under provisions of the agreements to which each is a party. The IP office of each TriDurLE member university will assess patentability and commercial potential and initiate pursuit of patent or other legal protection of their TriDurLE-sponsored research when appropriate.

Policies for Re-Use, Re-Distribution, and Production of Derivatives
We anticipate that there will be no access restrictions to the vast majority of data generated by TriDurLE. Exceptions may apply from time to time, as per WSU Patent and Copyright Policies and those of consortium member universities. Anyone requesting re-use, re-distribution, or production of derivatives from the work will be required to acknowledge our original contribution. The access to the experimental data obtained from TriDurLE-sponsored activities will have disclaimers and policies regarding the fair use of the data in other publications or products. WSU and the staff maintaining the Center's central database will make good-faith efforts to provide such data after careful review but do not guarantee that they are without any errors. WSU shall not be liable for any damage that may result from errors in the database. Access to the Center's central database is free of charge and thus it is prohibited to use any database spectra or information for profit-making or commercial use without obtaining proper permission from WSU and the IP owner for that specific dataset.

Upon the creation of joint IP resulted from collaborative research, each participating party or in the case of jointly held IP, parties, will determine whether it is appropriate to file a patent application and will notify the remaining members of the collaborative team of the decision. Each application will be funded at the

expense of owner(s) of the IP. Each participant will be free to publish its results; however, the publishing party will provide the other participants thirty-day period in which to review proposed publications, identify proprietary or confidential information, and submit comments. The publishing organization will refrain from publishing or disclosing proprietary or confidential information identified will give full consideration to all comments before publication. Potentially, upon request of a reviewing party, publication may be deferred for preparation and filing of a patent application which would serve to perfect its IP rights.

Plans for archiving and preservation of access
WSU resources include WSU Research Exchange (Dspace), a digital repository to store digital data and its descriptive metadata, organized by subject "communities." Materials deposited in the Research Exchange are visible through Google, Yahoo or any other Web search engines and typically show up at the top of search results due to the protocols used to deposit the items. The digital files within the Research Exchange are preserved so that access is possible over time. Authors of the digital files retain all copyrights to the information and may assign Creative Commons licensing so others may determine how the material may be used in later research projects.

The research team will make the collected dataset widely available across multiple resources. The non-sensitive dataset will be accessible through an open data hub free of charge to maximize public access. The TriDurLE researchers will decide individually whether they want to share their spectral data in the public domain. Data that are the subject of ongoing analysis for publication will generally not be made available except under special circumstances such as collaborative arrangements.

Data collected during the duration of this grant will remain archived at the WSU Research Exchange (https://research.wsulibs.wsu.edu:8443/xmlui/). Annual reports and published research papers will be deposited and stored for at least three years beyond the life of the project. The researchers are aware of no specific financial considerations which might impact the long-term management of the data. The research and archival staff of the WSU Office of Research will review this DMP upon accession of the data in order to ensure and demonstrate compliance.

Data Storage and Security
All participating faculty, staff and students associated with this Center work under the security guidelines established by WSU and their home institution. Within each institution, the IT Security Office is responsible for promoting a secure computing environment by overseeing information security policies, procedures, and practices for protecting core university data for all personnel and students. For instance, the WSU IT Security Office also provides consultation and support for departments, colleges, and student organizations in the areas of information security threat and vulnerability identification, protection of IT assets, and IT security incident response and investigations.