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# Proactive management of mobility impact of interdependent subsurface utility and roadway construction through incentives

*A Data Management Plan created using DMPTool*

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## Project abstract:

Civil infrastructure systems, such as roadways, pipelines and buildings, are among the largest investments in any society. Most of these infrastructure systems in the U.S. were built during World War II era and they have exceeded their design lifespans. Typically, infrastructure systems are located in close proximity, and are deployed underneath the urban roadway networks. When they breakdown, there is a need to cut through roadway pavements to access them - which in turn creates significant mobility implications to motorists. All of these indicate a tightly-coupled nexus of interdependencies amongst underground utility/infrastructure systems, roadways and motorist mobility. Most of the current approaches in managing these relationships and corresponding disruptions are reactive; resulting in longer times of impact, higher costs and significant mobility issues. There is an opportunity to rethink the current reactive approach and make it much more proactive and effective. The proposed research targets that through foundational works towards the development of: (1) predictive infrastructure maintenance operations that predict and coordinate major repairs amongst different infrastructure systems to minimize disruptions to a community; and (2) dynamic incentive/disincentive models provided to motorists to proactively manage and increase their mobility under a given maintenance related disruption. The proposed approach includes ethnographic studies around existing planned disruptions through maintenance, development of analytics for predictive maintenance and data-driven agent-based approach for modeling motorist behaviors under different incentives/disincentives and disruption situations, and development of an integrated analysis framework. If successful, the proposed research will provide the foundational work towards a first of a kind integrated predictive coordinated maintenance and mobility management framework. The research team will evaluate the framework through assessing how it reduces delays on the road network segments and travel time for standard origin destination pairs, and how it enables time and money savings for roadwork and utility companies through predictive and coordinated maintenance activities.

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## Data description

Describe the data that will be gathered in the course of the research project, including whether the data should be preserved for long-term access.

This project involves data related to: records of natural gas pipelines owned by People's Gas Company in City of Pittsburgh, including position, length, material, inspection frequency and year built; records of leaks and maintenance on natural gas pipelines owned by People's Gas Company in City of Pittsburgh, including date of report, reason of leaks, location of leaks, and date, type of maintenance; actual observation data of traffic during recent pipeline maintenances in City of Pittsburgh, such as vehicular volumes, speeds, travel times and vehicle emissions. Electronic files of raw data are stored on a secure server for long-term access.

## Data format and metadata standards

Describe the standards and machine-readable formats that will be used in the course of the research project.

The data collected will be stored as machine-readable formats and can be used by open-source softwares like Python to keep a widespread usage in the academic community.

The records of natural gas pipelines owned by People's Gas Company will be stored in formats of OpenFileGDB (.gdb) and Shapefile spatial data format (.shp). Geographical information systems (GIS) software like ArcGIS and QGIS are used to view, edit and export these data.

The records of leaks and maintenance on natural gas pipelines owned by People's gas Company in City of Pittsburgh will be stored in the formats of comma-separated values (.CSV) file and Microsoft Excel Spreadsheet (.xlsx). Microsoft Excel can be used to view, edit and export them.

Actual observation data of traffic during recent pipeline maintenances in City of Pittsburgh will be stored in the comma-separated values (.CSV) file.

Scientific programming packages like R, Python, MATLAB will be used to view, edit and export the data mentioned above.

Metadata of raw data including the date of data collected, codebook for each variable and coordinate systems for geographical data. The metadata will be stored with the raw data. Metadata of produced results and produced database during data analysis will be stored via careful attention to file naming conventions and meta-data tagging for each database.

## Policies for access and sharing

Discuss the access policies that will apply to the data, so as to protect against the disclosure of identities, confidential business information, national security information, etc. and whether public use files may be generated from the data.

Throughout the duration of the research project, the PIs will communicate findings with People's Gas Company by publications, conference presentations, and seminars. When possible and permitted, the raw data and the produced database during this project will be provided to private partners or public research community. Privacy, confidentiality and security of these database will be considered carefully during the sharing and storing of these databases.

Data produced with purely the open-source database will be made available to the public with the confirmation and access control of the PIs. When sharing these data, metadata and data dictionary will be provided for the users.

## Policies for re-use, redistribution, derivatives

Discuss the policies for re-use, re-distribution and derivative projects.

Without the violation of any agreements made with any stakeholders for this project, the data related to this project will be made available to research community for re-use. With the confirmation of PIs and other possible third parties, redistribution and derivatives are permitted and encouraged.

## Plans for archiving and preservation

Outline the plans for archiving and preservation, specifying where research data will be deposited, and specify that data will be deposited at the time of initial publication of any related peer-reviewed journal article.

Results and data derived from this project will be kept safely during at least a period specified in the DOT Data Sharing and Archiving Policies. Then the data will be kept and preserved on a server at CMU.