# Economic analysis tools for geotechnical asset management

## Description

“The term ‘asset management’ means a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost.’’ (23 USC 101(a)(2))

Federal rules in 23 CFR 515.9 encourage transportation agencies to incorporate in their Transportation Asset Management (TAM) Plans all infrastructure assets within the highway right of way. This may include geotechnical assets such as retaining walls, unstable slopes, embankments, and other asset classes whose functionality may affect the whole life cost and/or performance of the network. Federal rules mandate that pavement and bridge management systems be used to support the development and implementation of the TAM Plan for those assets.

Agencies wishing to implement geotechnical asset management will need to develop reliable quantitative tools, similar to those provided in pavement and bridge management systems, to implement asset management procedures for slopes, embankments, and retaining walls. The business processes to be supported would include:

* Summarizing asset conditions and performance gaps;
* Forecasting deterioration;
* Estimating the cost and effectiveness of risk mitigation, preservation, and reconstruction;
* Estimating risk, including the likelihood and consequences of service disruptions;
* Estimating life cycle costs;
* Selecting treatments for specific assets;
* Setting priorities and allocating resources within budget constraints;
* Setting performance targets in relation to fiscal constraints.

The analytical needs of geotechnical assets are simpler than those of pavements or bridges, and might be satisfied with a simple tool, such as a suitably configured spreadsheet and accompanying documentation.

## Objective

The objective of this research is to develop a simple model and documentation to support the business processes listed above, using appropriate methods and drawing on existing tools and research as much as possible. Agencies using the tool will populate it from their existing inventories and condition surveys for geotechnical assets. The tool is not intended for supporting inventory maintenance, inspection processes, or geographic analysis: it is to focus on economic analysis and planning of infrastructure investments. The tool developed in this project shall not contain any proprietary software or restrictions on end user rights. The spreadsheet files shall be compatible with Microsoft Excel 2013 or above.

## Benefits

The required tools will enable agencies to leverage their existing databases and geographic information systems to conduct the economic analysis required in support of developing and implementing TAM Plans for geotechnical assets. Most agencies do not have the capability to develop such tools, but often do have the capability to adopt and customize spreadsheets developed by others.

## Related Research

NCHRP 24-46 is developing implementation guidance for geotechnical asset management, but is not expected to perform the research necessary to develop the quantitative models described here. Many agencies have developed Rockfall Hazard Rating Systems that build on a visual assessment of slope characteristics to characterize the vulnerability of rock slopes. Similar methods have been used, less commonly, for soil slopes and for retaining walls. A number of agencies incorporate retaining walls within their bridge management systems and use deterioration and cost models developed for those systems. Some commercial software developers are marketing systems for management of asset inventories and condition surveys, and for mapping and other geographic analysis. These systems do not contain the required economic analysis, but might be interfaced with a spreadsheet tool having the required functionality.

## Tasks

It is envisioned that the research will involve at least the following tasks:

1. Review and synthesize the relevant literature including the sources listed above and any other publicly-available ongoing or completed work in the area.
2. Prepare a functional design document for the tool. The document will provide a first draft of worksheet formats (input data, calculations, and displays of results); a description of the methods to be used (including justification and mathematical formulas) and their capabilities and limitations; data requirements; and an outline of proposed documentation.
3. Solicit comments from the project Panel on the functional design document. Meet with the Panel to discuss the comments and proposed recommendations.
4. Based on Panel comments, refine and carry out the functional design, producing a draft spreadsheet tool. A draft of the documentation will also be included.
5. Provide telephone and email support as needed to enable the project Panel members to evaluate and comment on the draft spreadsheet tool.
6. Based on Panel comments, revise the tool and documentation. Solicit feedback from the Panel and make further changes as needed to ensure that the Panel comments are fully incorporated.
7. Finalize and submit the Final Spreadsheet and Documentation.

## Implementation

This research is envisioned to feed directly into TAM Plans and management systems for geotechnical assets. Continued FHWA and AASHTO support for asset management and performance management will help to ensure successful and widespread implementation. Depending on the quality of data and models obtained, the Panel may elect to conduct a follow up study to gather additional data for incorporation into the model. In the longer term agencies should be able to repeat the methodology with data collected over longer timeframes to improve and further customize the models.

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