# ASSET MANAGEMENT IN A WORLD OF DIRT

## Emergence of an Underdeveloped Sector of Transportation Asset Management

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The application of asset management techniques to geotechnical assets such as flexible rockfall protection systems has so far been mostly unexplored by transportation agencies.

PHOTO: DAVID A. STANLEY

Transportation agencies in the United States and worldwide are adopting transportation asset management (TAM) to focus strategically on the long-term management of government-owned assets (*1, 2*). As TAM concepts and tools have developed, however, they have not addressed all classes of assets—in particular, geotechnical assets such as retaining walls, embankments, rock slopes, rockfall protection barriers, rock and ground anchors, soil nail walls, material sites, tunnels, and geotechnical instrumentation and data.

Some state agencies have attempted to press forward in applying asset management principles to geotechnical assets, but the efforts have been isolated and limited. Many have not applied the gamut of the TAM process, starting from asset inventories and moving on to condition assessment and service-life estimates, performance modeling, alternative evaluation with life-cycle-based decision making, project selection, and performance monitoring (see Figure 1, page 19).

Most geotechnical asset management (GAM) efforts have halted at inventorying and conducting condition surveys, without progressing along the TAM spectrum. For example, agencies are unlikely to have specific performance standards for their geotechnical assets, and information about determining or estimating the service life of geotechnical assets is sparse. Nonetheless, much has been accomplished in the areas of assessing the corrosion and degradation of buried metal reinforcements in retaining walls and in estimating their remaining service life (*3–5*).

## Promoting the Principles

Recent efforts have begun to promote GAM. For example, the TRB Engineering Geology Committee formed a Geotechnical Asset Management Subcommittee to address research needs in this area. The subcommittee held its first formal meeting at the January 2011 TRB Annual Meeting.

In addition, efforts are under way to incorporate GAM principles into ongoing research and management programs:

- National Cooperative Highway Research Program (NCHRP) Project 24-35 is developing guidelines for the certification and management of flexible rockfall protection mechanisms that will include development of an asset management plan, long-

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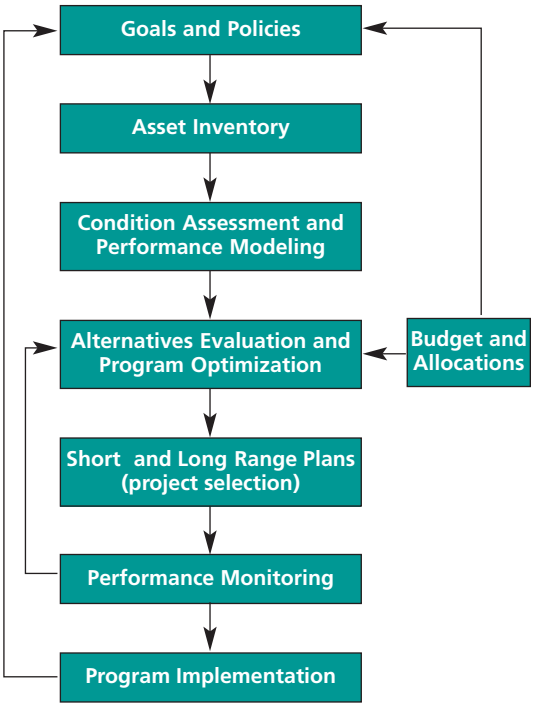


**FIGURE 1 Generic asset management system (*1*).**

term performance and condition measures, life-cycle cost estimating, and cost–benefit analyses for maintenance, repair, and replacement decisions.

- The Alaska Department of Transportation and Public Facilities (DOT&PF) is conducting research for a program that will apply asset management principles to the management of unstable slopes.
- Wyoming DOT has created a geology database to track and manage geologic maps, aggregate sources, and project information.
- The National Park Service has developed a Retaining Wall Inventory and Condition Assessment Program.
- Ohio DOT has a Retaining Wall Asset Management Program.

These efforts and others are starting points, but most are not integrated into a larger TAM program. Most states do not have geotechnical policies, goals, or performance measures. For the geotechnical asset programs that are in place, therefore, the nexus to agency goals remains tenuous.

## In a World of Dirt

TRB sponsored a symposium, Asset Management in a World of Dirt, in Oklahoma City in August 2010 in conjunction with the annual Highway Geology Symposium. The purpose of the TRB symposium, cosponsored by the TRB Engineering Geology and the Exploration and Classification of Earth Materials Committees, was to help practitioners address geotechnical assets in TAM initiatives. The symposium featured a keynote speech by Erik Loehr of the University of Missouri–Columbia, an early proponent of GAM and coauthor of key GAM publications (*6, 7*). Loehr reviewed the basics of asset management and addressed several GAM problem areas and research needs.

The six main speakers provided an overview of asset management principles and a perspective on GAM and its role. Other presentations addressed the issues associated with creating databases for conducting asset inventory and condition surveys and how GAM can provide a framework for managing the problem of the early degradation of buried structural components in retaining walls. Another presentation described the National Park Service's retaining wall inventory and the lessons learned in implementing the project. Two presentations were published as papers in the proceedings of the 61st Highway Geology Symposium (*8, 9*).

## GAM Goals

The goal of applying asset management principles to geotechnical assets is to reduce life-cycle costs (*3*). Agencies spend a significant portion of their funds on geotechnical assets. Every transportation asset rests on or is affected by a geotechnical asset—such as the ground and embankments on which roads are built and the rock slopes that adjoin roadways. Nevertheless, the length of service provided by a well-built embankment or an unseen bridge foundation receives little consideration—geotechnical assets often are neglected until they fail.

When geotechnical assets deteriorate, most transportation agencies resort to a "worst first" approach

A tieback wall on Richardson Highway in Alaska. Research on geotechnical asset management (GAM) is under way in Alaska, Wyoming, and Ohio.

PHOTO: C. T. BOECKMAN

Installation of soil nails along Alaska's Glenn Highway. An August symposium sponsored by TRB focused on managing degradation of buried structural components in retaining walls and other geotechnical assets.

in determining whether to repair, rehabilitate, or replace the asset and when. For example, rockfall inventory programs in many states rank rockfall sites so that the most dangerous receive first attention (*10*). Expending limited funds on worst-case problems, however, guarantees steadily declining conditions for transportation systems; asset management principles dictate spending to gain the most long-term, positive effects.

## Research Needs

Agencies implementing geotechnical measures in parallel with TAM efforts or integrated into those efforts face daunting hurdles. The possibilities for research are ample, and several aspects of GAM need explication. Although GAM practitioners have been conducting inventories and condition surveys for many years (*10*), progress into other areas of asset management for geotechnical assets has been slow. The following are critical needs:

- Devising performance standards and measures and establishing minimum levels of service; and
- Understanding the expected performance of geotechnical assets.

Some preliminary efforts have sought to identify performance standards specifically for geotechnical

PHOTOS: OREGON DEPARTMENT OF TRANSPORTATION

When a rockslide blocked the eastbound lanes of I-84 near Rufus, Oregon, in December 2010 (*left*), crews had to wait until morning to clear the debris and stabilize the slope (*right*). GAM allows transportation agencies to direct funds efficiently and reduce life-cycle costs.

assets, such as the unstable slope performance standards for Alaska DOT&PF (*11*). Most state DOTs, however, are not likely to have identified specific GAM performance standards. Creating performance standards may not necessarily be a complex task—logical standards can be derived from agency policies, goals, and consumer expectations.

After establishing the standards for geotechnical assets, the next step is to develop an understanding of the life cycle. Managers must be able to predict the condition of an asset at a certain time in the future. For some asset classes, such as pavement, deterioration curves can be created to chart the future life of the asset. The useful life of many geotechnical assets, however, cannot be charted on a neat curve.

One option for projecting the future condition of geotechnical assets is to start with a theoretical curve and then to perform a regression analysis to fit the curve. This process, however, can take many years. Formulas are available to calculate the expected service life of some geotechnical assets, such as buried retaining wall reinforcements and rock bolts (*3–5*). Considerable research is needed, however, to determine theoretical and actual service life and asset performance over time.

## Next Steps

Progress is under way in identifying and resolving inventory and condition survey issues for geotechnical assets. Many agencies have one or more inventory programs for retaining walls and for rock slopes. Nonetheless, agencies nationwide do not yet have a clear understanding of the next steps after completing a geotechnical asset inventory. GAM needs a framework and a roadmap to clarify how agency strategic goals and performance measures can be met through the implementation of GAM programs and to outline the steps to implement these programs.

Some of the framework for GAM was put in place several years ago (*6*), and the authors of the early work acknowledged the challenges, particularly in relation to agency goals and analysis tools. Minimal follow-up has built on these efforts to formulate a usable framework.

Research is needed to continue the development of GAM. The focus should extend beyond methods of conducting inventories and condition surveys to creating performance standards for geotechnical assets and finding ways to link agency goals to GAM implementation. Several research efforts are getting under way and show promise in integrating geotechnical concerns as key elements of TAM.

Improved understanding is needed about changes in geotechnical assets over time, which could allow for projections that can determine the optimum time to repair, rehabilitate, or replace an asset. Determining the characteristics of an asset's life will take many years of research projects. Some projects have taken the first steps, but more work is needed.

PHOTO: DAVID A. STANLEY

Larry Pierson, Landslide Technology, examines Nenana Canyon rockfall barrier, Parks Highway, Alaska, near Denali National Park.

## Down the Road

The TRB subcommittee on GAM is formulating research needs statements, focusing on how to move GAM beyond the initial steps. Research will look for ways to relate performance standards for geotechnical assets to the projected condition of the assets and will look further to the availability of analysis tools and their application to rational decision making about geotechnical assets, in accordance with asset management principles. The goal is to provide agencies with the optimal course of action for geotechnical assets.

Continued development of asset management for geotechnical assets is a critical part of the asset management puzzle. As asset management in transportation practice continues to mature, GAM must continue to make similar advances. When developed

PHOTO: DAVID A. STANLEY

Many states that have inventory programs for retaining walls and rock slopes often may lack a framework for implementing GAM principles to meet performance measures.

Photo: Pete Hardcastle

A materials site in Brooks Range, Alaska. The goal of GAM is to offer a framework for monitoring and predicting performance, enabling transportation agencies to make life-cycle cost–based decisions about geotechnical assets.

and implemented, GAM will offer a framework for monitoring performance to assure understanding of the current condition and to project the performance of geotechnical assets.

GAM offers transportation agencies the ability to make life-cycle cost–based choices about monitoring, rehabilitating, repairing, or replacing significant assets. As efforts continue to integrate geotechnical assets into the broader TAM effort, opportunities will arise for researchers in the world of dirt.

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Photo: John Duffy

Installation of soil nails and wire mesh in California.