2018 Midwest Geotechnical Workshop

Geotechnical Asset and Performance Management Implementation for Transportation Agencies - Outcomes from Project 24-46

Mark Vessely, P.E.
BGC Engineering, Golden, Colorado

bgcengineering.com
What is a Geotechnical Asset?

• Geotechnical Assets:
  – Retaining walls
  – Slopes
  – Embankments
  – Subgrades

  – The asset does not need to be distressed!
Portions of this discussion contain preliminary findings from NCHRP Study 24-46. These findings are based on the submission of draft deliverables and comment responses to NCHRP. The final research products should be published in the near future.

NCHRP 24-46 Study Team:
Mark Vessely, BGC Engineering
Scott Richrath, Atkins
Bill Robert, Spy Pond Partners
Omar Smadi, Iowa State University
Vern Schafer, Iowa State University
Erik Loehr and Andy Boeckmann, University of Missouri
NCHRP Study Overview:

Objective:
Produce a manual for implementing a geotechnical asset management program...provide plans and tools for a consistent management program that is flexible to allow varying adaptations by agencies as they integrate the geotechnical assets into overall asset management program.

• Guidelines to be consistent with and to supplement the AASHTO Transportation Asset Management Guide
• Provide agencies with a baseline risk-based asset management approach, considering MAP-21, FAST Act, and AASHTO-supported performance measures
Implementation of Geotechnical Asset and Performance Management

Why GAM  
Starting GAM  
Connecting to TAM  
Steps to Success

The Performance Framework

- From FHWA Transportation Performance Management Guidebook (https://www.tpmtools.org/guidebook/)
Assets Management in a Performance Framework

Opportunities for GAM to connect with the Strategic Performance the agency
• Manage assets to align GAM goals with agency performance goals
• Not about competing the same assets against each other, but the assets against the broader goals of the agency
What is the problem?

Could ~$100K-$200K treatment project rehabilitate the wall and preserve it for at least another 20 years?
Correlating to Pavement Asset Example

PCI

100

Excellent

Good

Fair

Poor

Very Poor

Failed

40% Drop in Quality

75% of Life

12% of Life

Spending $1 on preservation here...

...eliminates or delays spending $6 to $10 on rehabilitation or reconstruction here.

Galehouse et al., 2006
Implementation of Geotechnical Asset and Performance Management

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Life Cycle Cost View

- Actual outcome in performance based GAM
Is this good performance in the context of local and federal performance goals that relate to:

- Good stewardship of public funds
- Managing assets/system to the lowest life cycle cost
- State of good repair
- Sustainability
- Reliability and Efficiency
Do we know and communicate:

- The annual maintenance costs and needs for geotechnical assets?
  - Including the good performing assets?

- What portion of needs are being deferred?
  - Known versus unknown deferrals?

- What are the performance impacts from deferral of needs?
  - Increased life cycle cost?
  - Increasing frequency of disruption?
Connecting to Performance Management

• Performance Management:
  – Closely aligned with asset management; how do the assets affect performance?

• GAM can enhance the performance management culture by demonstrating how assets affect objectives
  – How does work of geotechnical staff connect with broader agency goals and direction?
Connecting to Performance Management

• How do geotechnical assets influence?

National Performance Goals for NHS

1. Safety
2. Infrastructure Conditions: State of Good Repair
3. Congestion Reduction
4. System Reliability- improve efficiency
5. Freight Movement and Economic Vitality
6. Environmental Sustainability
7. Reduced Project Delivery Delays

State Highway Agencies need to meet these goals for NHS
If given funds for asset management:

- What are the shelf list of GAM activities/projects?
  - For $100K
  - For $250K
  - For $1M

- Distinguishing needs from wants in terms of:
  - Cost-benefit ratios
  - Reduction in risk exposure
  - Quantified value of preservation and rehabilitation work
# Implementation of Geotechnical Asset and Performance Management

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## Why GAM

Google Street View: September 2017
For Any Asset

At any time in the operational phase, an owner will select one of the following treatment actions for each asset:

- Reconstruct
- Rehabilitate
- Maintain
- Do minimum
  - Do minimum can be a planned decision or the default action in the absence of GAM
September 3-4, 2018: ~18 hour closure for 28,700 ADT highway, emergency cleanup, and a TBD determined reconstruction/recovery cost
There is a cost of delaying GAM

Avoiding asset management does not eliminate the treatment decision or resulting consequence.
Shifting from Legacy Practices

• Geotechnical assets ≠ liabilities or hazards
  – Manage like other assets and avoid disruptive liabilities

• Geotechnical assets satisfy:
  – The definition of asset per AASHTO
  – International Organization of Standards (ISO) definition

• Geotechnical assets are managed assets in other countries and infrastructure systems
  – There is a precedent and benefits are being realized:

>230,000 slope and embankment assets managed for U.K. Highway and Network Rail agencies
Asset Management Overview

• Goal of asset management (any asset):
  – To align asset design, operation, maintenance, and upgrade decisions with the *goals and objectives of the agency*

• Much more than bridges and pavements
  – In 2004, first international standardization process across 50 public and private entities in 15 sectors and 10 countries
  – Many guidance resources available
Financial responsibility for GAM

• Without GAM:
  – Accepting unknown levels of risk to safety, mobility, and economic vitality while potentially making unfavorable life-cycle investments

• With GAM:
  – Stewardship of taxpayer funds
  – Good business practice for making investment decisions with limited funds
  – Can evaluate potential changes with time due to agency investment options and external threats
Managing Performance Risk with GAM

- Measure and communicate performance risk
  - Move from an unquantified “thing” to a known and accepted residual risk
Defining Geotechnical Assets

- Geotechnical assets are the retaining walls, slopes, embankments, and subgrades that contribute to the ability of an agency to perform the strategic mission
Retaining Walls: constructed structures that hold back natural soil or rock or engineered materials to prevent sliding of material onto a roadway or other structure, or support a roadway.
**Embankments**: constructed earth fill comprised of soil or mixtures of rock and soil that enables a roadway to maintain a required design elevation above lower lying ground.
**Slopes:** A permanently excavated slope (a cut-slope) that is incorporated into the roadway template and within the ROW, easement, or other property boundary.
**Subgrades:** constructed earth material below the engineered pavement layers that creates a life-cycle management need.
GAM Taxonomy Formulation

Implementation of Geotechnical Asset and Performance Management

Why GAM  Starting GAM  Connecting to TAM  Steps to Success

* Modified slope, embankment, and subgrade geotechnical assets contain non-earth inclusions such as anchorages, reinforcements, protection elements, or ground improvements.
GAM Taxonomy Formulation

- Knowledge
- Equipment
- Data
- Non-Agency Structures/Private Walls, etc.
- Material Sites
- Water Bodies
- Natural Slopes
- Natural Hazard Sites
- Stockpiles or Other
- Other Asset Types with Geotechnical Elements
- ROW Asset
- Geotechnical Asset

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Steps to Success
Role of Agency Boundary

• Assets within the boundary
  o Geo-assets are owned and maintained by agency
  o Generally full control – like bridges and pavements

• Hazards originating beyond the boundary
  o Not owned, but possibly managed through reactive means
  o Often associated with a natural hazard site – a geohazard
  o Best considered a “beyond the ROW” feature
Geohazards result from geotechnical, hydrotechnical, tectonic, and snow and ice processes – such as subsidence, landslides, debris flows, erosion, flooding, liquefaction, avalanche and permafrost degradation.
Role of ROW/Boundary

- Assets in the ROW – Designed, Constructed, and Maintained by Agency

- Deteriorating embankment within ROW
- Wall and Slope (rock cut) on ROW and within boundary
Comparing Geotechnical Assets and Beyond the ROW features

Rockfall originating from the slope asset above is due to physical deterioration of a cut made by the agency and also the O&M responsibility of the agency.

Rockfall originating from the natural cliffs above are natural events that may effect O&M but also would have occurred with or without the highway being present.
Life-Cycle for Starting GAM

Focus on starting GAM over certainty and complexity in TAM steps

- *Don’t let “the perfect” become the enemy of “the good”*
Introducing AM Maturity

**INITIAL**
- Existing data, LOS, & management strategies
- Identifies shortcomings and future priorities
- Emphasis on major assets

**CORE**
- Demand forecast
- Life cycle strategies
- Long-term financial projections
- Comprehensive asset coverage

**ADVANCED**
- Optimized long-term asset program
- Risk management plan
- High-confidence financial forecasts

Source: FHWA-NHI Course 136106B (2017)
Implementation of Geotechnical Asset and Performance Management

Why GAM  Starting GAM  Connecting to TAM  Steps to Success

AASHTO Asset Management Steps

- Objectives and Measures
- Inventory and Condition
- Investment Strategies
- Financial Plan
- Performance Gap Identification
- Life-Cycle Cost and Risk Management

Ongoing activities and process improvements
Connecting GAM to TAM and Performance

• GAM must be a sound business process with measurable outcomes for success

• Enabling success through:
  – Connecting asset performance to customer perspectives
    • How are users impacted?
  – Connecting asset performance to agency executives
    • How is the agency impacted?
Understanding our Objectives

• What are the highest level goals and performance objectives in your agency?
• Any of these words used:
  – Safety
  – Mobility
  – Maintenance
  – Good State of Good Repair/Condition
  – Economic vitality
  – Improve Business Practices
  – Manage Risk
Understanding our Objectives

**INDOT Mission**

INDOT will plan, build, maintain and operate a superior transportation system, enhancing safety, mobility and economic growth.

**Fiscal Year 2019 Agency Goals – Taking INDOT to the Next Level**

**Deliver Great Service**
- Demonstrate accountability by doing what you say you’re going to do at all times
- Improve Customer Service responses and issue resolution
  - Be thorough, consistent, and patient, consistently meeting customers’ needs
  - Collaborate and communicate effectively with internal and external stakeholders
- Modernize and increase productivity to better improve service offerings
  - Improve construction and maintenance processes and business practices

**Enhance Indiana’s Economic Competitiveness and Quality of Life**
- Improve connectivity via multiple modes of transportation
- Increase understanding of Indiana’s position as it relates to the autonomous/connected vehicle industry, and undertake initiatives to advance testing and research in the state
- Support and encourage local agencies in their efforts to develop and implement sustainable plans for their futures

**Execute a 20-year Road and Bridge Plan**
- Deliver the Next Level Roads plan to improve pavement and bridge quality, safety and mobility
  - Priority given to construction zone safety for workers and motorists
  - Focus on engineering, education, enforcement and emergency response
- Identify continuous improvements of the Asset Management process
  - Strive for improved collaborations with all stakeholders – Internal and external
- Convey Next Level construction projects through effective and efficient communication strategies

**Develop INDOT’s 21st Century Workforce**
- Provide more complete job-training capabilities across the agency
- Provide employees with tools and information needed to succeed
- Deliver enhanced leadership training opportunities
Understanding our Objectives

**Strategic Areas of Focus**

- **Leadership**
  - Align the organization to carry out the MDOT mission, achieve the vision and demonstrate the values.
  - Strategies
    - Establish clear, measurable and aligned performance goals and desired outcomes across the organization.
    - Regularly evaluate organizational performance and adjust direction as necessary.

- **Customer-centered**
  - Understand our customers’ most important needs to achieve a more customer-focused agency that results in better service and lower cost.
  - Strategies
    - Align our programs and services to be responsive to customer feedback.
    - Be accountable and transparent to our customers through tracking and reporting on MDOT’s key performance metrics.

- **System Focus**
  - Provide cost-effective, integrated and sustainable transportation solutions.
  - Strategies
    - Apply asset management principles to prioritize and implement the most cost-effective transportation investment strategies.
    - Optimize the value of transportation investments by employing solutions that consider all users and modes and how the entire transportation network is used to move people, goods and services.

- **Safety**
  - Move Michigan toward zero deaths through the incorporation of safety in all our transportation efforts.
  - Strategies
    - Foster communication, coordination and collaboration with our public and private safety partners to achieve the goal.
    - Prioritize MDOT safety investments toward those with the highest probability to move us toward the goal of zero deaths.

- **Partners**
  - Foster and sustain partnerships to optimize operations and achieve customer-centered results.
  - Strategies
    - Prioritize and strengthen partnerships that create organizational efficiencies and optimize the contribution of transportation investments to Michigan’s economy.

- **Innovative & Efficient**
  - Move people and goods through better customer-centered services and performance-driven decision-making.
  - Strategies
    - Pursue innovations, transformational changes and organizational efficiencies that lead to investing more in the transportation system.
    - Manage performance to provide value and better customer-centered results.

- **Workforce**
  - Recruit, develop, and retain a high-performing workforce.
GAM Performance Measure: Level of Risk (LOR)

LOR: A single measure that connects with several executive and customer measures and objectives

Level of Risk (LOR) is a metric determined in GAM Planner process.
GAM Measure – Level of Risk

- Examples of different LOR grades for geotechnical assets
  - more than just condition, but what the asset is doing to performance
Customer Performance Measures

• Can your agency measure the following?
  – Safety incidents associated with geotechnical asset performance
  – Hours of closure and delay associated with geotechnical asset performance
  – O&M costs for assets
Technical Measure Options

- Internal measures that relate to geotechnical performance characteristics
- Using inventory data, example measures:
  - % of segments in each O&M Condition Level
  - % of segments in each Safety Risk Consequence Level
  - % of segments in each Mobility and Economic Consequence Level
Moving on from Objectives and Measures