Best Practices for Conducting Indicator-based Vulnerability Assessments using the Vulnerability Assessment Scoring Tool (VAST) Virtual Workshop

Location: Virtual Workshop (webinar)

Date: March 6, 2019

Virtual Workshop Overview and Goals

The Federal Highway Administration (FHWA) hosted a Virtual Workshop on March 6, 2019 via Adobe Connect. The purpose of the Virtual Workshop was to facilitate sharing of insights and best practices for conducting indicator-based vulnerability assessments using VAST between State Departments of Transportation and Metropolitan Planning Organizations. Additionally, the Virtual Workshop sought to provide participants with access to experts in VAST and vulnerability assessments.

The Virtual Workshop consisted of introductions and goals from all participants, an overview of vulnerability assessments and VAST, highlights of selected topics relevant to vulnerability assessments, and a series of roundtable discussions where participants had the opportunity to ask additional questions. The agenda is available in Appendix A: Agenda and a list of participants is available in Appendix B: Participant List.

Welcome & Introductions

Becky Lupes, FHWA, welcomed participants, shared objectives, and encouraged attendees to participate in an active discussion. Ms. Lupes expressed the hope that attendees make connections across the group and leverage this opportunity to develop their understanding of vulnerability assessment best practices.

Cassie Bhat, ICF, welcomed participants and facilitated a series of introductions, as follows:

Previous VAST Users:

- Elizabeth Habic, Maryland Department of Transportation State Highway Administration (MDOT SHA), provided an overview of her experience using VAST and conducting vulnerability assessments. Ms. Habic also discussed MDOT SHA's existing climate change vulnerability viewer and activities associated with integrating results into practice.
- Casey Clark, Ohio Department of Transportation (ODOT), provided an overview of the ODOT Asset Reliability Study, which is currently about 60% complete. Goals of the study include: performing a vulnerability and risk assessment of ODOT bridges, large culverts, and pavement (statewide); involving district personnel throughout the study; developing an accurate tool to rank assets according to vulnerability; and developing a workplan that ODOT personnel can utilize in capital planning & decision-making.
- Chris Dorney, WSP, discussed his experience with facility-level engineering assessments and indicator-based vulnerability assessments, including working with Minnesota DOT, Massachusetts DOT, Southeast Florida MPO, Pinellas County (Florida), and Caltrans.
- Cassie Bhat, ICF, provided an overview of her experience developing and applying VAST at a range of scales (e.g., 9 assets to 10,000+ assets). Her work includes the Gulf Coast Study Phase 2 as well as projects with the Capital Area MPO, the U.S. Fish and Wildlife Service, and the National Park Service.

New VAST Users:

- Participants from the Capital Region Planning Commission included Jamie Setze, Ravi Ponnapureddy (Director of transportation), and Drew Ratcliff (Regional Disaster Manager)
- Gina McCullough and Patty Pearson from Bi-State Regional Planning Commission participated with the aim to determine if VAST is the best option for their vulnerability assessment. Ms. McCullough expressed a concern about data availability in the region.
- Jessica Forrest from the Naval Facilities Engineering Command (NAVFAC) described existing efforts to assess 66 bridges along the East & Gulf Coast using VAST. Ms. Forrest described challenges associated with data collection, particularly accessing necessary geospatial data.
- Cory Lynn Golden, Joey Kaspar, and David Dang participated from the Houston-Galveston Area Council (H-GAC). H-GAC is conducting a vulnerability assessment for an eight-county region with a focus on sea level rise, storm surge, and heavy precipitation. H-GAC described challenges with determining critical transportation assets, indicator selection, and presentation and validation of results.
- Rachael Barlock participated from the Southeastern Michigan Council of Governments (SEMCOG) along with Jim Schultz from the Michigan DOT (MDOT). SEMCOG and MDOT are working together to conduct a climate resiliency and flooding mitigation analysis on roadway systems, with a particular need to address depressed freeways in metropolitan Detroit.

The introductions also covered several other attendees from FHWA, including Heather Holsinger, Betsy Tracy, Rob Kafalenos, Andy Pickard, and Sean Litteral.

Introduction to Vulnerability Assessments and VAST

Following the Introductions, Ms. Bhat introduced vulnerability assessments and VAST, including a live demonstration of the tool. The overview included a mention of relevant resources (e.g., the Vulnerability Assessment and Adaptation Framework), components of vulnerability, approaches for vulnerability assessments (stakeholder input approach, indicator-based desk review, and engineering informed assessments), and key considerations for using VAST.

One participant asked a question about the amount of time that is commonly needed for data collection. Presenters agreed that often the majority of the effort can be spent on data collection and data processing, and that it's worth comparing available data with desired indicators in order to develop an effective methodology.

Highlights of Selected Topics

During the next series of sessions, presenters (Elizabeth Habic, Casey Clark, Chris Dorney, and Cassie Bhat) first provided an overview of their thoughts about selected topics. Participants were then able to ask follow-up questions.

Key Themes & Lessons Learned

Insights from presenters indicated several key themes for successful vulnerability assessments and best practices for VAST, including:

- **Engagement**: It's important to engage engineers, asset-owners, and other staff familiar with assets to help identify relevant indicators and encourage buy-in of the results.
- **Iterative Processes:** Based on the amount of time and resources available, it can be effective to use an iterative process to create agreement between desired indicators, data availability, and data collection requirements.
- **Resource Considerations**: Methodology development and the associated data collection and processing are typically the most time-consuming and resource intensive steps in the vulnerability assessment effort.

Selecting and Scoring Indicators

This session discussed how agencies have collected data, selected relevant indicators, and scored assets. Elizabeth Habic, MDOT SHA, provided some examples of indicators using in their vulnerability assessment, including: modeled sea level change inundation depth, proximity to coastline, past experience with storm surge, and underclearance. Casey Clark, ODOT, discussed their process for developing indicators, which included meetings with each of the 12 districts within the state. These meetings helped the project team to develop two separate methodologies (one for bridges/culverts and one for highways). Most of the data used in these methodologies will be derived from various ODOT management systems or a basic GIS analysis. Chris Dorney, WSP, distilled general lessons learned on selecting and scoring indicators, including:

- *Selecting:*
    - Carefully define units of analysis (e.g., bridge points, road segments)
    - Think twice before screening out non-critical assets (e.g., non-critical roads may be built to lower design standards and thus impacted more frequently, which could be costly)
    - Consider multiple climate scenarios & timeframes
    - Anticipate messy data, as most pre-existing data will be created for a different purpose and may be challenging to address formatting
    - Avoid redundant metrics
    - Utilize engineering knowledge to ensure metrics used are good indicators
    - Beware of false positives (e.g., straight overlays of roadway networks with inundation layers can indicate that bridges are exposed when in fact they are not)
    - Capture impacts to system users (e.g., AADT, detour length)
    - Match level of effort to available resources
    - Limit analysis to assets/hazards with high quality data
- *Scoring*:
    - Allow for future data updates
    - Consider the spatial extent of scoring (e.g., score statewide or by district)
    - Score only exposed assets
    - Put each metric's raw values on a common scale
    - Allow metrics to have different weights (based on importance and level of confidence)
    - Assign exposure metrics the most weights
    - Weight impacts that happen sooner heavier

- Conduct sensitivity tests for weighting schema
- Note the most significant metrics for each asset (e.g., report out the top three factors that go into the score to easily check results)
- Use multi-hazard scores for final prioritization

Cassie Bhat, ICF, also noted that the process of selecting indicators is often iterative, and it can be helpful to review indicators that have been used elsewhere (e.g., FHWA 2013-2015 Pilots Final Report, Table 2). In addition, it's important to remember that using more indicators does not necessarily correlate with better results (e.g., use less than 5 indicators for any given component).

After the initial presentations, one participant, asked about the similarities and differences between VAST and INVEST. Becky Lupes and Heather Holsinger from FHWA answered that INVEST is a self-evaluation tool used to assess the sustainability of planning processes, operations, various other program aspects, while VAST is specifically for vulnerability assessments.

Ground-Truthing Results

This session discussed how agencies have ensured results are consistent with past experiences & existing understanding. Elizabeth Habic, MDOT SHA, described how Maryland was able to leverage work from a university to develop high resolution data layers. Ms. Habic also described how her team was able to validate flood mapping using Google Earth data. Casey Clark, ODOT, described how his team used a second round of district interviews to refine indicators, weights, and results. Ultimately, the project will also develop three case studies (bridge, pavement, and culvert) that contain a detailed review of adaptation options. These case studies will help to ground truth results. Cassie Bhat, ICF, described best practices for ground -truthing results, including:

- Incorporate some measure of past experience as an indicator (e.g., survey of maintenance staff/asset owners)
- Allow maintenance staff/asset owners to review draft results, perhaps through interactive maps. Consider asking such questions as: Does anything surprise you? Is anything highly vulnerable that shouldn't be there? Is anything not showing up that you would expect to?

Visualizing Results

This session discussed how agencies have visualized results in a meaningful or useful way. Elizabeth Habic, MDOT SHA, described Maryland's online climate change vulnerability viewer and how it has been used within the agency for visualizing results. Casey Clark, ODOT, described the challenges of choosing a platform to model the results. ODOT recommended that when choosing a platform for visualizing or interacting with results, consider accessibility or system constraints (e.g., security issues). ODOT ultimately opted to use an Excel spreadsheet system to visualize results. Chris Dorney, WSP, recommended that agencies consider reporting results by individual hazard, climate scenario, and time period, as well as holistically across hazards, scenarios, and time periods. Mr. Dorney also recommended classifying results into different categories, translate numeric scores into verbal descriptions, and spending time creating effective maps. Cassie Bhat, ICF, noted the importance of being able to show overall vulnerability scores as well as disaggregated components. Ms. Bhat also emphasized the value of using maps to visualize results and noted that VAST can export results back into a geospatial environment for mapping purposes.

Roundtable Discussion: Using VAST

In the last session, participants asked questions of the presenters, who responded and provided general advice on several topics:

- What is the best strategy for conceptualizing adaptive capacity as compared to criticality, considering the overlap between these components? Presenters noted that there is often overlap in the types of indicators or criteria used to evaluate criticality and adaptive capacity. It is important to keep in mind this possibility for overlap and avoid any double-counting of indicators in the scoring approach. Many agencies use the adaptive capacity assessment in lieu of a criticality screen, but some agencies perform an initial criticality screen and also include adaptive capacity in the vulnerability assessment methodology. While some assets will be more critical than others, there may still be a range in the adaptive capacity levels of even the most critical assets. Resource constraints may limit an agency's ability to perform both an initial criticality screen and a complete vulnerability assessment.
- With regards to data availability, Casey Clark from ODOT noted that it was difficult to identify where Ohio has experienced previous flooding issues. This data gap might be a common problem for other agencies.
- Presenters noted the importance of creating well defined scores (1-4) for every indicator and coordinating with asset owners. This type of coordination helps to garner buy-in from everyone involved.

Key Lessons Learned

Throughout the Virtual Workshop, presenters touched on several key lessons learned:

- VAST can be applied to a range of scales (e.g., 9 assets to 10,000+ assets).
- Methodology development and the associated data collection and processing are typically the most time-consuming and resource intensive steps in the vulnerability assessment effort. Half (or more) of the process can be devoted to deciding on the methodology, which includes collecting the data and making decisions about which indicators to use and how to score and weight them. It can be worth comparing between desired indicators and available data.
- Agencies have found it can be helpful to separate out adaptive capacity from exposure and sensitivity. Exposure and sensitivity combined tell whether an asset is likely to be damaged by flooding. Adaptive capacity is more relevant at a systems level; including adaptive capacity can flag assets that are not particularly exposed or sensitive but are critical to the system. Overall, it can be helpful to unpack into various components of the overall vulnerability score.
- It's important to engage engineers, asset-owners, and other staff familiar with assets to help identify relevant indicators and encourage buy-in of the results. For example, to develop indicators, Ohio DOT held meetings with each of the 12 districts within the state (large input of time and travel resources). These meetings provided a good sense of what should go in the VAST model.
- When choosing a platform for visualizing or interacting with results, consider accessibility or system constraints (e.g., security issues).
- Based on the amount of time and resources available, it can be effective to use an iterative process to create agreement between desired indicators, data availability, and data collection requirements.

Appendix A: Agenda

Best Practices for Conducting Indicator-based Vulnerability Assessments using the Vulnerability Assessment Scoring Tool (VAST)

Virtual Workshop Agenda

March 6, 2019, 1:00 – 4:00 PM Eastern

Location: Adobe Connect

Introduction	

1:00 PM	**Welcome/Introductions**
	• Welcoming remarks and goals for the peer exchange
	• Participants with experience using VAST (5 minutes/person): describe goals for vulnerability assessment, scope, example results, use of results
	  ○ Elizabeth Habic, Maryland DOT State Highway Administration
	  ○ Casey Clark, Ohio DOT
	  ○ Chris Dorney, WSP
	  ○ Cassie Bhat, ICF
	• Participants new to VAST (5 minutes/agency): describe goals for vulnerability assessment, scope, challenges, goals for peer exchange

1:40 PM	**Brief Introduction to Vulnerability Assessments & VAST (ICF)**
2:00 PM	**Break**
Highlights of Selected Topics For each of the topics below, the discussion will include: • Presenters share experiences, lessons learned, best practices • Group discussion and follow-up questions from participants	
2:10 PM	**Selecting and Scoring Indicators** *How have agencies collected data, selected relevant indicators, and scored assets?*
2:30 PM	**Ground-Truthing Results** *How have agencies ensured results are consistent with past experiences & existing understanding?*
2:50 PM	**Visualizing Results** *How have agencies visualized results in a meaningful or useful way?*
Roundtable Discussion: Using VAST	
3:10 PM	**Challenges & Advice for Using VAST**
3:45 PM	**Other Questions about Vulnerability Assessments**
3:55 PM	**Wrap Up**

Appendix B: Participant List

Name	Organization	Role
Becky Lupes	FHWA	Organizer/Presenter
Cassie Bhat	ICF	Organizer/Presenter
Chris Dorney	WSP	Organizer/Presenter
Hannah Wagner	ICF	Organizer
Casey Clark	Ohio Department of Transportation	Presenter
Elizabeth Habic	Maryland Department of Transportation State Highway Administration	Presenter
Andy Pickard	FHWA Michigan	Participant
Cory Lynn Golden	Houston Galveston Area Council (H-GAC)	Participant
Heather Holsinger	FHWA	Participant
David Dang	H-GAC	Participant
Jessica Forrest	Naval Facilities Engineering Command (NAVFAC)	Participant
Joey Kaspar	H-GAC	Participant
Rachael Barlock	Southeast Michigan Council of Governments (SEMCOG)	Participant
Sean Litteral	FHWA	Participant
Jim Schultz	Michigan Department of Transportation	Participant
Patty Pearson	Bi-State Regional Commission	Participant
Gina McCullough	Bi-State Regional Commission	Participant
Rob Kafalenos	FHWA	Participant
Jamie Setze	Capital Region Planning Commission	Participant
Ravi Ponnapureddy	Capital Region Planning Commission	Participant
Drew Ratcliff	Capital Region Planning Commission	Participant
Betsy Tracy	FHWA	Participant