Statement No. 34

Arkansas State Highway and Transportation Department
Transportation Research Committee

RESEARCH PROBLEM STATEMENT

DATE: 09/12/2016 | **PROJECT AREA:** Planning

TITLE: Understanding the Resilience of the Arkansas Transportation Network

PROBLEM STATEMENT:

Between 2000 and 2009, the United States recorded 300 natural disasters resulting in $344 billion dollars of total damage. These figures represent more than 300% growth in the number of disasters occurring per decade since the 1970s with the cost of damage increasing 30-fold. The transportation system is especially vulnerable to extreme disasters and damage to the network resulting from disasters has compounding effects on mobility, safety, and the economy. Thus, robust analyses are needed to not only assess the resilience of the transportation network but to determine ways to increase network resilience. A resilient system has "...the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event" (National Infrastructure Advisory Council). The benefits of understanding and planning resilient systems are evident for state DOTs. In fact, the FAST Act highlights and incorporates 'resilience and environmental mitigation activities' as key program feature. In the face of many possible disaster scenarios, the AHTD must first assess the resiliency of the existing transportation network according to appropriate resiliency-based performance measures. As an example, one possible metric for system resiliency is type and timeliness of mitigation and restoration activities executed before, during, and after a disaster occurs. The timeliness of these activities is a key feature of a resilient system; however, the time scales of these activities vary dramatically as long-term mitigation activities such as expanding roadway capacity or adding parallel, redundant routes take a considerable monetary investment and planning horizon. Alternatively, emergency restoration activities such as clearance of debris or route detour signage must be conducted rapidly (e.g., days) in order to return to an acceptable Level-of-Service (LOS) as quickly as possible. This study will provide the AHTD with a foundational resiliency assessment complemented with recommendations for the best steps forward for developing mitigation and restoration plans. Such an assessment will allow the AHTD to vie for FAST Act funds dedicated to development and support of resilient systems planning. In short, this project represents a necessary step toward improving the resiliency of the Arkansas transportation network.

OBJECTIVES:

Success of this research involves completion of three research phases. Phase 1 will synthesize relevant state and federal reports, NCHRP studies, and academic articles to define resiliency performance measures (PMs), set appropriate PM targets, and outline methods to quantify economic benefits of resiliency planning. In Phase 2 historical and forecast vulnerability analysis will be performed based on defined PMs. For the historical analysis (2.1), the location, type, and magnitude of different historical extreme events will be evaluated. A vulnerability analysis (2.2) will be conducted by identifying vulnerable transportation network components based on predicted scenarios of future extreme events (e.g., at risk for flooding due to proximity to a body of water). For tasks (2.1) and (2.2) state transportation network data and corresponding traffic volumes will be extracted from the AR Statewide Travel Demand Model. With this data, the study will simulate different disaster scenarios on the transportation network and measure LOS changes over time. The third research phase will conduct a resiliency improvement analysis to determine the best plans and procedures for mitigation and restoration activities. The possible mitigation and restoration activities will be evaluated based on their ability to better meet the identified resiliency PM targets. Additionally, the study will perform a cost benefit analysis by examining the trade-offs in cost to resiliency improvement.

FORM OF RESEARCH IMPLEMENTATION:

In addition to a final report outlining the results of the three phase research study, this research will create a series of GIS maps. The maps corresponding to Phase 2 tasks will show the current and predicted resiliency PMs across the Arkansas transportation network. This will help the AHTD identify hot-spots in the network associated with increased vulnerability under different disaster scenarios as well as demonstrate how different disaster and recovery scenarios cascade across the network. The next series of visualizations will highlight the most cost-effective long-term mitigation plans for improving resiliency PMs. These maps will provide valuable tools for the AHTD to understand and explain the effectiveness of different restoration plans in terms of their impact on the resiliency of the transportation system.

REVIEWER: Tymli Frierson

Estimated Project Duration: 24 month

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Standing Subcommittee Ranking	Advisory Council Ranking	Statement Combined with Statement Number(s)
5/6	24	