TDOT
Department of
Transportation

Research Summary

Project Title: Rapid Emergency Evacuation Planning/Assessment for Tourist Attractions and Isolated Communities

Project Number:
RES (2021-10)

TOOT Lead Staff:
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Project Term:
(Month Year) to (Month Year)

WHAT WAS THE RESEARCH NEED?

The U.S. experiences hundreds of significant disasters and emergencies that prompt intervention from the Federal Emergency Management Agency (FEMA) in the form of financial and logistical support. Additionally, numerous other emergency events may not receive national declarations but still pose grave risks to human life. Tennessee is no stranger to such crises, frequently experiencing severe storms, floods, and fires. The state has also been affected by other weather- related calamities like tornadoes, severe ice storms, snowfalls, and even hurricanes that have been declared national emergencies. Notable examples include the severe flooding in Knoxville in 2019 (DR-4427) and Nashville in 2010 (DR-1909), as well as the devastating wildfires in Gatlinburg in 2016 (DR- 4293), all of which received presidential disaster declarations. A process available and tested tools including detailed evacuation network, day/nighttime population info, and microscopic simulation can help local emergency planning.

WHAT WERE THE RESEARCH OBJECTIVES?

To address the disaster evacuation challenges and provide a planning framework incorporating readily available tools that can be used for smaller and less resource-rich communities and municipalities, the following objectives were identified for this study.

- *Objective 1 - To Develop an Easy-to-Use Modeling Work/low.*
- *Objective 2 - To Improve Preparedness.*
- *Objective 3 - To Help Identify Critical Infrastructure and At-Risk Populations/Locations.*
- *Objective 4 - To Provide Insights for Community Engagement.*
- *Objective 5 - To Plan for Future Deployment*

WHAT WAS THE RESEARCH APPROACH?

This study proposed, implemented, tested, and demonstrated an emergency evacuation modeling framework called T-REX, or Tennessee Rapid Evacuation Microsimulation. The purpose of the effort is to provide a simple workflow for the implementation in smaller isolated communities or tourist attractions where we often observe 1) captive transportation network options and exit capacity, 2) significant number of visitors unfamiliar with local hazards or evacuation options, and 3) limited resources for planning, modeling, or executing complex evacuation operations.

WHAT WERE THE FINDINGS?

Key findings of the study include 1) the demonstrated timely and rapid implementation of T-REX framework for modeling a handful sites in the state of Tennessee; 2) the economical implementation of the framework because each component was off-the-shelf, tested, and essentially free to use by the public; 3) the framework has the flexibility to be implemented by different agencies with past experience or current preference if different simulation software, population data, or transportation network were to be employed; and 4) the results from T-REX process are to be compared relatively and interpreted carefully by researchers and practitioners to provide insightful recommendations to decision-makers.

IMPLEMENTATION AT TOOT

- **Timely Implementation:** The T-REX framework proposed and tested in this study demonstrated that the research team was able to complete the precatory work for utilizing a microscopic simulation software package in a timely fashion. Evacuee information in terms of both daytime and nighttime populations and locations within the evacuation zone were imported from

LandScan USA and the transportation network coded directed from OpenStreetMap. It does take some time to assign evacuation destinations for each evacuee and the time they are loaded onto the network based on their locations in the network.

- **Economic Considerations:** All components selected for implementation in this study, from the population database (LandScan) to the transportation network (OpenStreetMap) to the simulation engine (SUMO), are open, tested, off-the-shelf, and free to the public. This makes it more feasible to implement for local agencies.

- **Flexibility in the Framework:** T-REX is a framework that can be implemented with different component choices. Alternative components such as Streetlight population data, ESRI GIS maps, and VISSIM simulation package or similar can all be used to substitute the open and free components we used in this study.

- **Results Interpretation:** The simulation of the myriad scenarios at various study sites yielded animation clips, congestion maps, bottleneck locations, traffic control strategies, and traffic operation statistics.

MORE INFORMATION

Find the final report here:

https://www.tn.gov/content/dam/tn/tdot/long-range-planning/research/final-reports/RES2021-10%20-%20Final%20Report%20Approved.pdf