LTRC RESEARCH PROJECT CAPSULE

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TECHNOLOGY TRANSFER PROGRAM

Development of a Time-Dependent Hurricane Evacuation Model for the New Orleans Area

JUST THE FACTS

Start Date:
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Duration:
24 months

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Funding:
Louisiana Transportation Research Center

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology
- Implementation Potential

PROBLEM

Current hurricane evacuation transportation modeling uses an approach fashioned after the traditional four-step procedure applied in urban transportation planning. One of the limiting features of this approach is that it models traffic in a static manner. That is, link flows are modeled as the total flow occurring on a link during an analysis period, such as a morning peak, with no indication of the variation in traffic flow during the period. In addition, static trip assignment assumes that trips complete the journey from origin to destination during the analysis period. During a hurricane evacuation, trips can take up to 20 hours, necessitating long analysis periods if static assignment is used. These two features, long analysis periods and no indication of the variation in traffic flow during these periods, are serious limitations on the integrity of the modeling process. Congestion is critical in estimating evacuation clearance time, evacuation efficiency, and the proportion of evacuees evacuated. Other differences between ordinary day-to-day urban travel and evacuation travel include uncertainty of road conditions, the possibility that destinations may change due to road closures or lack of accommodation, and the fact that an evacuation trip is mandatory rather than discretionary.

In urban transportation planning, the emphasis is on estimating link flows so that infrastructure needs can be identified. In evacuation planning, the need is to estimate traffic conditions that allow the estimation of evacuation clearance times, evacuated population, and locations of congestion and delay in the network. An evacuation planning model, therefore, needs to answer questions such as:

- How does traffic demand develop as a hurricane approaches a coastal community?
- What are the consequences to flows on the network if individual links are becoming impassable due to flooding?

High winds and flooding are dangers caused by hurricanes.

- How do incidents such as crashes, stalled vehicles, and vehicles that have run out of gas influence flows on the network?
- What percentage of evacuees will follow the guidance/ diversion information provided by authorities and what are the resulting impacts?
- How does congestion build up and dissipate on certain crucial links of the transportation system?
- How can we best utilize the capacity of the transportation system through staged evacuation?
- What are the overall impacts of certain evacuation policies/ traffic management decisions, such as the nature and timing of evacuation orders, initiation, and termination of contra flow?

Clearly, these questions cannot be adequately addressed by applying traditional urban transportation modeling procedures to evacuation situations. A new approach, tailored to the dynamic nature and specific needs of evacuation planning, is needed.

OBJECTIVES

The overall objective of this study is to advance the state-of-the-art of hurricane evacuation demand modeling from that already achieved in earlier research conducted by the Louisiana Transportation Research Center (LTRC) (Fu, 2004). Specifically, the objective is to design and test a new method of collecting time-dependent hurricane evacuation data, develop a new time-dependent evacuation destination choice model, and to test the impact of using dynamic traffic assignment in the estimation of evacuation flows rather than static assignment.

The new method of data collection will involve developing a time-dependent stated preference (SP) survey procedure in which hypothetical storms are presented audio-visually using video footage from past hurricanes and studio enactments recorded specifically for the project. The cost of data collection using the SP method will be compared with that of the traditional revealed preference (RP) method (using Hurricane Katrina as the case reported on). The performance of models estimated on the SP and RP data will be compared by observing how well they reproduce evacuation behavior when applied to a storm not included in either data set but on which evacuation behavior and link flows have been observed.

The evacuation destination model will be a time-dependent disaggregate choice model that uses time-dependent evacuation demand as input, and allows destination choice to be sensitive to the fixed and changing conditions on the network and the destination. Fixed conditions are the characteristics of the evacuee and his/her environment. Changing conditions include characteristics of the storm, network, destination, and management strategies implemented by emergency managers as the storm develops.

METHODOLOGY

The principal investigator will conduct a survey using the new method and the traditional method and compare the results. The comparison will involve the cost of data collection and the accuracy of models estimated on the two data sets when used to estimate evacuation from a past storm on which evacuation response was measured. Data from Hurricane Georges in New Orleans will be used for this purpose.

The evacuation destination choice model will be developed using reported destination choices from past storms and validated with traffic counts recorded at the time of evacuation. The initial model will be developed using evacuation data from South Carolina in response to Hurricane Floyd in 1999, but will be tested using data from the data collection exercise mentioned in the previous paragraph and traffic counts on evacuation routes out of New Orleans.

The accuracy of dynamic traffic assignment procedures will be assessed by observing how well estimated traffic flows reproduce observed traffic counts when loading reported evacuation demand on the transportation network in New Orleans. Alternative dynamic traffic assignment procedures will be evaluated, and the impact of duration of the time interval in the time-dependent analysis system assessed.

IMPLEMENTATION POTENTIAL

The deliverable of this project is a set of transportation planning tools that enhance the ability to plan for hurricanes in New Orleans. The system should be capable of analyzing the regional traffic dynamically, and be responsive to different evacuation policies and operational strategies, such as evacuation order (time, sequence, and type), lane-closure, contra flow, incidents/accidents, diversion strategies, and the impacts of different ITS strategies on diverse user groups.

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