

RES2016-29: Multi-Modal Freight Transportation System Capacity and Diversion Assessment

Principal Investigators: Janey Camp, Vanderbilt University janey.camp@vanderbilt.edu

Hiba Baroud, Vanderbilt University hiba.baroud@vanderbilt.edu

PROBLEM STATEMENT

Tennessee's economic health relies heavily on the timely and efficient flow of commodities which is governed by a multi-modal freight transportation system. There is growing concern regarding the ability of such an interconnected system to withstand disruptive events and maintain the necessary level of commodity flow to support the economy and mitigate cascading impacts. Ideally, multi-modal transportation systems should provide redundancy in the network of freight movement to ensure effective diversion in the event of a disruption to one or more modes. Added complexity is introduced due to emerging interests in expanding commuter rail service by utilizing portions of the freight rail network. A case in point is the mobility challenge facing middle Tennessee, where the passenger rail option may be constrained by the nearly maximized capacity of CSX freight lines. These circumstances beg the following questions: 1) To what extent is the freight system in Tennessee operating at or near full capacity? 2) How does that impact the performance of freight transportation and opportunities for passenger rail service? 3) How capable is the system for handling freight diversion in the case of disruptive events?

OBJECTIVES

The research will focus on a data-driven, comprehensive analysis of multi-modal freight system capacity to understand the system's capability to: 1) serve the anticipated demand for freight (and possibly passenger) traffic and 2) be able to accommodate additional commodity flow in the event that diversion is needed. Multiple data sources will be considered, including information maintained by TDOT, various agencies with the U.S. Department of Transportation, the U.S. Army Corps of Engineers, Bureau of the Census, and a variety of industry associations. The geographical focus will be the middle Tennessee region, a logical candidate with the area serving as a key east-west and north-south corridor, housing the third-largest switching hub in the CSX network, and experiencing considerable population and business growth. This year-long study will focus on developing and applying the methodology in the middle Tennessee area, with the anticipation that the work can be extended to include the entire Tennessee freight system as a future project expansion. The deliverable of this research will be a report that provides an assessment of current system capacity, as well as an indication of the challenges and opportunities TDOT and its partners face in providing an improved and sustained multimodal transportation system under anticipated conditions.

SCOPE

Successful completion of this project will involve performing the following tasks:

Task 1. Data Assembly and Preparation. Assemble all available historic/empirical data as well as future projections (as available) for freight and passenger flows and traffic for key corridors in the middle Tennessee region on rail and highways. Anticipated data sources include FAF data, TDOT data, the Nashville Metropolitan Planning Organization's Regional and 2040 Plans/Models, Nashville Metropolitan Transit Authority (MTA) data, the Carload Waybills, and others. This data will be compiled and appropriately formatted for analysis using ArcGIS.

Task 2. Determine Capacity and Identify "Hot Spots". Capacity and Level of Service will be calculated for each main highway/interstate route, rail line, etc. in the area. Using ArcGIS software, maps 3 indicating current "capacity" or use of the system will be created for current and future projections. These will serve as a baseline of the system from which future projections for flow can be compared. Additionally, future projection flows will be mapped. For both present-day and future projections, "hot spots" where the infrastructure system is at or near capacity will be identified.

Task 3. Develop and Model Scenarios for Disruption. To evaluate system disruption capabilities, a small set of potential disruption scenarios will be identified (in coordination with TDOT) for events such as a highway bridge outage due to flooding or man-made event, extreme flooding of a key rail line, and/or earthquake damages to bridges and overpasses at select "hot spot" locations. Use of the "hot spot" locations presents a "worst-case" scenario for disruption at locations that are either critical or are already strained in terms of traffic flow and capacity. Each scenario will have a specific type of disruption identified and outage/delay time applied. The disruptive event will be "modeled" to determine the area/extent of impact,

Task 4. Identify Alternative Routes and Capacity Impacts of Disruptions. Routing tools within GIS will be used to analyze diversion options across all modes for passenger and freight flows through the Middle Tennessee region. A subset of maps will be created showing the location of each disruption, the alternate flow paths and indicating "capacity" of segments/nodes in the system as a result of the disruption.

Task 5. Synthesis of Findings and Preparation of a Final Report. We will synthesize the findings and identify lessons learned in the approach/methodology used for possible application in other regions of Tennessee. A final report will be performed and submitted to TDOT for review and comments.

In addition to these activities, an ongoing task throughout the entire project will be coordination with TDOT to discuss study results and planned activities, report preparation, and other engagement, as appropriate. For this reason, such coordination is not listed as an independent task, but rather embedded in the performance of each of the aforementioned tasks.

TIME PERIOD

The proposed period for this research project will be 12 months, with an anticipated start date of August 15, 2016.