MarTREC UTC Project Information Form
USDOT Tier 1 University Transportation Center
Agency ID or Contract Number 69A3551747130

Project Title: A Policy and Infrastructure Evaluation Model of Commodity Flows through Inland Waterway Ports
Project Abstract (Brief Description): The purpose of this project is to guide strategic investment into port capacity through the development of a policy and infrastructure evaluation model of inland waterway commodity flows. A multi-stage stochastic optimization model will be developed to evaluate tradeoffs in strategic, long-term port infrastructure investment with mid-term capacity expansion decisions and provision of complementary highway infrastructure made by public and private stakeholders, and shorter-term operational practices made by shippers and carriers. This work builds on prior MarTREC projects which developed a Multi-Commodity Assignment Problem to estimate annual commodity flows through inland waterway ports from truck Global Positioning System (GPS), marine Automatic Identification System (AIS), and the Lock Performance Management System (LPMS). The proposed project will explore critical extensions of the assignment model: 1) disaggregation of the temporal scope to reflect monthly seasonality among commodities, 2) incorporation of uncertainty related to observed vehicle and vessel movement data, and 3) inclusion of transportation costs. With these extensions the team expects to increase the accuracy and resolution of the commodity-based port throughput estimates and to allow the model to be used to not only describe the current system but to prescribe policy and project investment strategies for public and private sector transportation decision makers. Calibration and validation of the multi-stage optimization model will be done through two case studies. The regional-based study will use historical truck GPS, marine AIS, and LPMS datasets. The national-based study will use data from the Billion Ton Study led by the US Department of Energy. This will ensure a feasible and realistic base-case on which to compare future policy scenarios. This project aligns with MarTREC's research focus area in Maritime and Multimodal Logistics Management by modeling commodity flows through ports that serve as critical connections for the multimodal freight supply chain.
Describe Implementation of Research Outcomes (or why not implemented) - Place any photos here *To be determined upon conclusion of the project*: The general approach of the proposed work will be to formulate a multi-stage stochastic optimization model to build on the foundations presented by of prior work to model commodity flows. The model will evaluate the impacts of past and current investments in port capacity expansions and the impacts of transportation-related policies on current and future shipment volumes, mode selection, and port selection by using observed data of vehicle, vessel, and commodity flows (truck GPS, AIS, LPMS). Additional data will be gathered on transportation costs in the form of fuel costs, fuel consumption rate, shipping rates, etc. from a variety of sources. After uncertainties are revealed, each stage depicts seasonal commodity flows between ports that result from strategic, planning, and operational decisions that balance the various (conflicting) objectives of stakeholders. Factors capturing uncertainty include unbalanced monthly commodity tonnage/volume observed between locks and transportation costs.
Impacts/Benefits of Implementation (actual, not anticipated) *To be determined upon conclusion of the project:* The model will be applied to two case studies for validation. One of the case studies will focus on a regional and the other on a national scale problem. The first case study will model the movement of commodities along the MKARNS. Since there is abundant data about commodity flow, barge and truck movements, the first case study will closely model the operations within each port including the estimation of monthly (seasonal) port utilization

and throughput. The second case study will investigate the biomass supply chain along the Mississippi River. This problem has a wider regional footprint. Thus, the focus is to evaluate the impacts that infrastructure improvements and policies implemented in one region have on commodity flow and port utilization in other regions. While the geographical scope of these case studies is somewhat different, the lessons learned complement one-another.
Web Links: martrec.uark.edu
Budget (Funding) Amounts & Source(s) (US DOT +Match(s) =Total Costs): MarTREC funds $114,460. Matching funds $61,090. Total funds $175,550.
Project Start and End Dates: August 2020-September 2022. Complete
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