MarTREC
Maritime Transportation Research & Education Center

MarTREC UTC Project Information Form
USDOT Tier 1 University Transportation Center
Agency ID or Contract Number DTRT13-G-UTC50

Project Title: Dynamic Decision Modeling for Inland Waterway Disruptions

Project Abstract (Brief Description): The inland waterway system is a major component of the U.S. transportation system. Disruption on the inland waterway system can have widespread economic and societal impacts, and their consequences can be significant. However, the uncertainty associated with the disruptive events, such as extreme weather conditions, have made it difficult to determine whether it is optimal to stay on the water and wait for the locked traffic to clear, or it is more economical to redirect to rail or freight transportation. In order to facilitate decision making in the event of waterway closure under uncertainty, this research proposes a dynamic multi-criteria decision framework that can be used to find a timely and optimal solution for the greatest overall societal benefits. The potential contribution of this research is threefold: (1) this is the first study to incorporate uncertainty in the decision process when facing inland waterway disruption; (2) it proposes the idea of collaborative planning in the event of disruption when all stakeholders' decision goals are considered simultaneously; and (3) it develops a user-interactive real-time decision support tool that can automate the decision process and propose an optimal solution in a short period of time.

Describe Implementation of Research Outcomes (or why not implemented):
Collected and studied lock and dam closure reports, with a focus on unscheduled, weather-related disruptions. Reasons for closure and duration of disruptions were recorded. A Markov Decision Process (MDP) model was developed from the barge owner perspective that considers the uncertainty in the status of the closed or partially closed lock and dam as well as the traffic and safety status of barges remaining on the waterway. The optimal policy from the MDP model determines whether it is more economical to reroute using another mode of transportation or to wait on the waterway.

Impacts/Benefits of Implementation (actual, not anticipated)
Considering the objectives of our research, it helps the decision maker reduce the cost. Mainly, commercial companies using transportation service through the inland waterway system will receive pecuniary benefit by reduced cost. In addition, it will make positive impact on supply chain members by reducing untimely deliveries. Using the developed decision support tool will bring visible and invisible profits together.
Another impact of implementation is the changes in the decision maker's attitude. The expected value is usually used as the sole decision criterion because it is easy to calculate and to understand. However, to find at least reasonable result, we are required to use several approaches and tools together with the expected value. The framework helps persons understand decision making process under uncertainty and the developed tools reduce the required work for analysis.
Consequently, it helps managers make decisions based on not intuition but analysis. Actually, the framework can be applied to any decision making problem accompanying uncertainty. The last benefit of implementation is the improvement of the decision making supporting tool by date that would be accumulated continuously. The most important work in decision making under uncertainty is to make plausible probability distribution of the uncertainty and to anticipate the most likely outcome based on given information. To have high confidence on the prediction and the hypothesis concerning probability distribution, we require as much as data possible. It is only achieved through implementation in practice during a certain period. Thus, we can naturally expect the improvement of the support tool.

Web Links: martrec.uark.edu

Budget (Funding) Amounts & Source(s) (US DOT +Match(s) =Total Costs): $155,218 MarTREC + $80,947 Salary Release = $236,165

Project Start and End Dates: 08/01/14-12/31/16 Project Complete

Principal Investigator(s) and Contact Information: Shengfan Zhang Ph.D and Heather Nachtmann Ph.D
Principal Investigator Institution (University): University of Arkansas

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