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

Project Title: Optimal Dredge Fleet Scheduling - Phase 2 Research

Project Abstract (Brief Description): The excavation of US waterways, commonly known as dredging, is vital to our economy. Without navigable waterways, transportation of product may be disrupted. Oversight of dredging operations is a challenging problem because a decision-maker must (i) choose from numerous potential locations that are in need of dredging and (ii) schedule selected jobs within allowable environmental windows. In its simplest form, this series of decisions can be broken into two problems: (1) Job Selection Problem and (2) Job Scheduling Problem. In prior research projects supported by MarTREC and the Army Corps of Engineers, investigators Rainwater, Nachtmann and Sullivan have developed the first quantitative optimization tools to assist decision-makers with the a deterministic, one-year variant of the Job Scheduling Problem. This methodology has already been integrated into Corps computing systems. However, all previous work assumes that the decision-maker has been provided a preselected set of jobs for scheduling consideration. A quantitative system for comprehensive consideration of dredge job selection does not exist. The failure to integrate the selection and scheduling process suggests that opportunity exists for significant financial and operational benefits for transportation planners. This proposed research seeks to provide new quantitative tools that address this need by leveraging the expertise developed in this area by the team of investigators.

Describe Implementation of Research Outcomes: The achievements in this project have been communicated to leadership at USACE. An update version of dredge optimization code is scheduled for transfer to USACE systems in mid-January 2018. Decision-makers will be using this updated tool at Winter 2018 planning meetings in the Northwest USACE region.

Impacts/Benefits of Implementation: This work provides two models that serve as the first quantitative tools for multi-year dredge planning at the USACE. The models introduce an interdependence between jobs not needed to this point in dredge scheduling research. This new interdependence has been captured compactly through the novel use of covering constraints to minimize complexity and variable space explosion. Practical insights into the change in dredge resource needs as one move from a single-year to multi-year perspective are noteworthy. Moreover, the significant deviation in the dredge travel versus idle time are magnified in a multi-year planning horizon. However, it is clear that this more general model requires signicantly more computational time from those developed for the single-year dredging problem in previous work. This suggests that the focus of dredge optimization work for the USACE should shift from building more flexible models (the focus of the last 2 years of research) to time spent on methodological enhancements in the constraint programming framework. Specifically, computational investigation into intelligent variable branching, quick-start meta heuristics and

integrated CP/optimization tools that make use of a highly parallelized computing environment are necessary paths forward.
Web Links: martrec.uark.edu
Budget (Funding) Amounts & Source(s) (US DOT +Match(s) =Total Costs): $49,903+$36,481=$86,384
Project Start and End Dates: 08/15/16-08/14/17 project extension granted to 11/30/17. Project complete.
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