Supply vessel planning with uncertain demand and weather conditions

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Abstract

Supply vessel planning problem arises in the upstream offshore oil and gas logistics, where supply vessels are the most expensive logistics resource. A fleet of supply vessels provides delivery of necessary materials and equipment to a set of offshore installations on a periodic basis from an onshore supply base. The challenge is that the performance of the vessel schedule is affected by both uncertain weather conditions and uncertain demand at installations. The objective is to define an optimal fleet composition and a least-cost weekly sailing plan used repetitively over a season. Uncertain weather conditions influence both sailing and service times leading to delays. Uncertain demand quite often leads to inability to deliver all the planned cargo on time due to insufficient vessels deck capacity. The uncertainty results in the rescheduling where in the worst case an extra vessel is hired at a higher cost. Rescheduling involves several recourse actions performed simultaneously in various combinations and aimed to ensure feasibility of the schedule. Logistics planners aim to create vessel schedules with minimized schedule's deterministic cost and the expected cost of recourse. We present an optimization-simulation methodology for the construction of supply vessel schedules. We develop a heuristic algorithm able to generate solutions with some reliability level against uncertain demand and weather for large real-life problem instances. The heuristic algorithm is combined with a discrete event simulation to assess the performance of the schedule and to compute the expected cost of recourse.

Keywords: Vehicle routing, energy logistics, optimization, simulation

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