

TOPS: Advanced Decision Support System for Port and Maritime Chemical Logistics*

Xue WU** · Hong Choon OH*** · Iftekhar A KARIMI****
Mark GOH***** · Robert de SOUZA*****

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Abstract

This paper presents a decision support system named the Tanker Operations Planning System (TOPS). It is a user-friendly software with an advanced routing and scheduling algorithm to automate and aid the operational decision making process. It considers the key operations constraints faced by the tanker owners. The advanced routing and scheduling algorithm embedded in the decision engine uses heuristics to solve industrial scale problems under actual operating conditions. Besides, TOPS can easily generate the routing, scheduling, stowage plan and the financial reports, and it can process a large number of orders online as well. In addition, TOPS can be conveniently modified for evaluation purposes or to suit the preference of the tanker owners. In essence, TOPS is an effective optimization-based decision support system to assist the parcel tanker carriers to systematically and objectively plan vessel routes and schedules with the goal of maximizing profits and fleet utilization in a structured manner. Drawing from actual data provided by a tanker company operating in the Asia Pacific, our simulation results show that TOPS can generate a cost effective routing and scheduling plan of a large scale problem to within a practically acceptable time of around 10-20 minutes

Key words : Chemical Logistics, Decision Support System, Routing and Scheduling, Mixed-Integer Linear Programming

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** Research Engineer of The Logistics Institute- Asia Pacific, National University of Singapore, Email: tliwx@nus.edu.sg

*** Analyst of Singapore Health Services, Singapore, Email: oh.hong.choon@singhealth.com.sg

**** Propessor of National University of Singapore, Email: cheiak@nus.edu.sg

***** Director of The Logistics Institute- Asia Pacific, National University of Singapore and Professor of School of Management, University of South Australia, Email: tligohkh@nus.edu.sg

***** Executive Director of The Logistics Institute- Asia Pacific, National University of Singapore, Email: tlihead@nus.edu.sg

I. Introduction

Parcel tankers, which are the transport conduits of raw materials and finished products for the chemical industry, offer the flexibility in ferrying multiple cargoes from their respective origins to designated destinations without having to adhere to fixed routes or fixed arrival and departure schedules.

However, with the increasing price of oil and the relentless global demand for maritime transportation, the Tanker Routing and Scheduling Problem (TRSP) has attracted much research attention. For instance, bunker fuel prices, which have hit a two-and-a-half year high in 2011 of US\$680 per ton, can make up as much as 70% of the operating costs of a vessel, depending on its type.¹⁾ Hence, the interest persistent in this field of study. Moreover, this problem is further complicated by the constraints which are capital intensive and subject to strict safety regulations imposed by environmental regulators.

Although advanced optimization tools exist in the container shipping businesses which also face a similar complex ship routing and scheduling problem, many parcel tanker carriers still rely on human judgment and manual experience-based procedures to plan a vessel's route and schedule. As a result, inefficient business operations continue to prevail, which in turn curtails their true earning potential.

To bridge the gap, a decision support system named Tanker Operations Planning System (TOPS) is developed. It is a user-friendly software with an advanced routing and scheduling algorithm to automate and aid the decision making process. It considers the key operating constraints faced by the tanker owners, such as cargo-to-cargo compatibility, cargo-to-tank compatibility, cargo stowage conditions, cargo pick up laycans, tank cleaning times, requirements and costs, and deadweight limits.

II. Solution Methodology

Many heuristics have been developed to address the Vehicle Routing and

1) <http://www.bunkerindex.com>.

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