Transportation Research Part E 83 (2015) 111–125

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Modeling downstream petroleum supply chain: The importance of multi-mode transportation to strategic planning

Yasaman Kazemi [a,*], Joseph Szmerekovsky [b]

[a] Transportation and Logistics Program, North Dakota State University, NDSU Dept. 2880, P.O. Box 6050, Fargo, ND 58108, United States
[b] Department of Management and Marketing, North Dakota State University, NDSU Dept. 2420, P.O. Box 6050, Fargo, ND 58108-6050, United States

ARTICLE INFO

Article history:
Received 20 May 2015
Received in revised form 19 August 2015
Accepted 14 September 2015

Keywords:
MILP model
Multimode transportation
Strategic planning
Petroleum distribution network design
Geographic information system
Logistics decisions

ABSTRACT

This paper proposes a deterministic mixed integer linear programming (MILP) model for downstream petroleum supply chain (PSC) network to determine the optimal distribution center (DC) locations, capacities, transportation modes, and transfer volumes. The model minimizes multi-echelon multi-product cost along the refineries, distribution centers, transportation modes and demand nodes. The relationship between strategic planning and multimodal transportation is further elucidated. A case study was considered with real data from the U.S. petroleum industry and transportation networks within Geographic Information System (GIS). A scenario analysis is also conducted to demonstrate the impact of key parameters on PSC decisions and total cost.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

The oil industry has one of the most complex and advanced supply chains around the world. It is vertically integrated, covering activities from exploration to transformation in refineries and product distribution with a large logistic network. It includes production, transportation, transformation into several refined products, and distribution to consumer markets. The whole supply chain is divided into upstream, midstream and downstream. The structure of a generic oil supply chain is shown in Fig. 1.

The upstream activities include exploration and production of crude oil. Exploration includes seismic, geographical and geological operations. The midstream segment consists of refining, infrastructure and modes used to transport crude oil by pipeline, tankers or rail depending on the distance, the nature of the product and, the demand volumes to various refineries and storage tanks (Briggs et al., 2012). The downstream consists of processes that follow refining, including transportation, marketing and distribution of petroleum products.

Since the petroleum industry is characterized as highly capital intensive, considerable financial commitment, time and effort have been devoted to develop mathematical programming tools to support decision making in the planning process (Oliveira et al., 2014; Fiorencio et al., 2014). The petroleum supply chain has been addressed in the literature based on the decision levels as well as the section of the supply chain.

* Corresponding author.
E-mail address: yasaman.kazemi@ndsu.edu (Y. Kazemi).

http://dx.doi.org/10.1016/j.tre.2015.09.004
1366-5545/© 2015 Elsevier Ltd. All rights reserved.

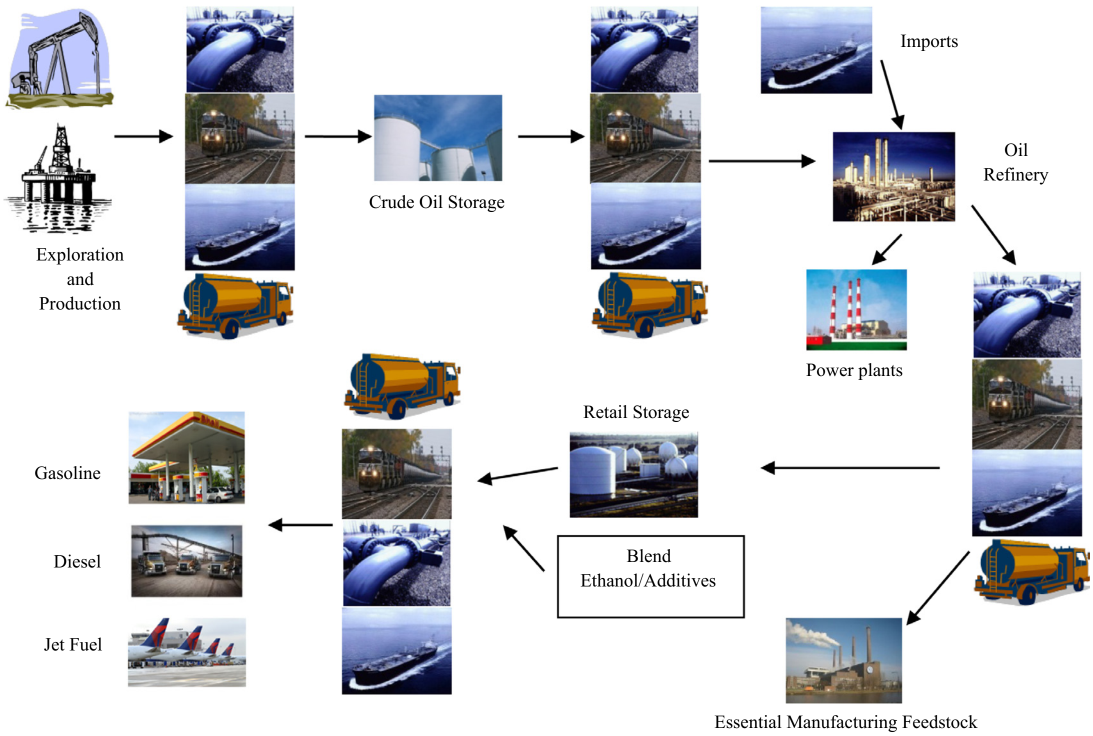

Fig. 1. The structure of the oil supply chain.

In the upstream section, the majority of the models support decision making that includes the selection of oil wells to be drilled and operational decisions such as crude oil transportation, scheduling and platform production. Aronofsky and Williams (1962) developed a multi period linear programming model for oil well production. Decision variables include production rates for oil wells, the number of wells drilled, the number of rigs purchased, and the number of rigs in operation. Similarly, Kosmidis et al. (2002) developed a mixed integer optimization formulation for the well allocation/operation of integrated oil/gas production systems. Iyer et al. (1998) developed a multi period MILP for planning and scheduling the infrastructure and operations in offshore oil fields' facilities. A sequential decomposition strategy followed by successive disaggregation was proposed to solve the problem. Van Den Heever and Grossmann (2000) proposed a multi period nonlinear model for oilfield infrastructure planning which involved continuous and discrete decisions. In addition, Ierapetritou et al. (1999) studied the problem of selecting the optimal vertical well locations by formulating a large scale MILP and solving by a decomposition technique based on applying quality cut constraints. Crude oil transportation was addressed by several authors. Mas and Pinto (2003) addressed oil scheduling in a distribution complex which is composed of marine terminals, storage tanks, and pipelines with an MILP model. Material flow of crude oil from port to refinery tanks and distillation units is modeled by Chryssolouris et al. (2005).

In the midstream sector, substantial work in the literature has been devoted to the decisions related to the processes inside the refinery such as refinery production planning and scheduling. Decisions related to the supply for process units, production and refinery optimization have been addressed in several studies. For example, Lee et al. (1996) focused on scheduling of crude oil supply in the short term for a single refinery. Pinto et al. (2000) addressed production scheduling for several specific areas in a refinery such as fuel oil, crude oil, LPG and asphalt. Pinto and Moro (2000) focused on production planning in a refinery. Similarly, another study conducted by Ponnambalam et al. (1992) solved a multi-period planning model in the oil refinery industry. Jia and Ierapetritou (2003) proposed an MILP for customer order scheduling and gasoline blending. Other studies related to the midstream activities can be found in Li et al. (2004), Lababidi et al. (2004), Koo et al. (2008), Robertson et al. (2011).

Most of the studies of the downstream oil supply chain have dealt with designing the network and determining the material flow (An et al., 2011). The mathematical programs apply to distribution of products, optimization of transporting products from the refinery to the market, and sometimes considering storage and blending (Fiorencio et al., 2014). Sear (1993) was the first study to address supply chain management and logistics in the downstream supply chain. The author developed a linear programming model that involved crude oil purchasing, transportation to the depots and customers by considering different costs at each stage.

Downstream PSC network design models include Al-Qahtani and Elkamel (2008) who studied a mixed-integer programming model to minimize cost in the strategic planning of a multi refinery network and to develop a methodology for

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات