



Warehouse sequencing in the steel supply chain as a generalized job shop model

Günther Zäpfel*, Michael Wasner

Institute of Production and Logistics Management, University of Linz, Austria

Received 14 April 2004; accepted 13 October 2004

Available online 8 December 2004

Abstract

Warehouse management plays an important role in efficient steel supply chains. In particular, optimal scheduling for all warehousing activities is a challenging task in this context: Handling incoming coils from the steel facility, placing these coils in their dynamically assigned locations in the warehouse, determining a sequence in which the outgoing coils, corresponding to the current customer orders, should be visited by the crane in order to cover all delivery necessities on time. To capture all the dynamic situations of the warehousing processes, we formulate our problem as a generalized dynamic job shop sequencing model and develop a heuristic solution concept for a real warehouse (logistic centre) of a steel supply chain.

© 2004 Elsevier B.V. All rights reserved.

Keywords: Warehousing; Steel supply chain; Dynamic sequencing; Storage assignment

1. Introduction

Warehouse management plays an important role for many efficient supply chains. In particular, warehouse management in the steel industry has the task to efficiently decouple the production rhythm of the steel maker from that of steel customers. Time- and cost-intensive set-up processes in the steel industry provide the major motivation for operating in campaign mode, whereas steel customers (e.g., the automotive and white-goods industry) produce their goods in a more continuous way. Similar problems arise in the paper industry.

In this paper, our central focus of warehouse management concerns the actual sequencing, scheduling and routing of the movement of goods and therefore falls in the area of operational decisions. Warehouse

*Corresponding author. Inst. für Produktions- und Logistikmanagement, Johannes-Kepler-Univ. Linz, Altenberger Strasse 69, Linz A-4040, Austria. Tel./fax: +43 732 2468 9464/9422.

E-mail address: guenther.zaepfel@jku.at (G. Zäpfel).

activities in the steel industry comprise all movements of goods (in our case steel coils of different sizes and qualities) that are conducted daily: handling incoming coils from the steel facility, placing coils in their dynamically assigned locations in the logistics center (warehouse), and determining a sequence in which the customer orders (outgoing coils) should be visited by the overhead crane in order to service all delivery requirements on time, whereby priorities for customer orders can be given.

The movement of goods in the logistics center can be classified in three kinds of orders:

- Storage orders.
- Retrieval orders.
- Restorage orders within the logistics center.

Storage orders are triggered by incoming coils that are transported to the logistics center at an input point (input docking station) every day. The number of input docking station locations is limited to a certain number of storage spaces. Incoming coils are delivered from the steel facility by a shuttle in certain known time intervals. Warehouse management has to ensure that incoming coils can be assigned to a free location within the input docking station every time unit and must, therefore, allocate incoming coils to storage spaces on time within the logistics center.

Retrieval orders are the result of fulfilling customer (outgoing) orders, which must be transported to an output point (output docking station). The output docking station consists of location OUT from which the coils are loaded onto the transport means (trucks, railway wagons, etc.). Only one means of transport can be dispatched every time unit. A customer order consists of one or more coils.

The coils can be stored on two levels in the logistics center: a lower and an upper storage level (coil rack position; see Fig. 1). Only coils that are situated on the upper level and coils in the lower level that are not covered by other coils can be taken out of stock directly. For all other retrieval orders, *restorage orders* have to be executed.

Restorage orders occur if a customer order includes coils that are stored on a lower level and whose location is covered by other coils. The coils, on an upper level must first be transported away by the overhead crane to enable transporting the outgoing coils to the output docking station. In this case, for every blocked coil on the lower level, one or two restorage orders for the covering coils have to be executed in time to enable transporting the customer order to the output docking station. In Fig. 1 the numbers on the lower coils symbolize how many restorage orders are necessary for the respective coils to be taken out of stock. Furthermore it must be ensured that a coil can only be stored in an upper storage location if the two positions below it are occupied by coils.

An overhead crane conducts all coil transports between any two storage locations. The travel times between two locations within the logistics center depend on the distance and the travel speed of the crane. A good approximation for the distance is given by the measure of Euclidean metric or L_2 norm, i.e., $\sqrt{\Delta x^2 + \Delta y^2}$ when Δx and Δy denote the translations in horizontal and vertical direction of the crane. If we denote the travel speed per distance unit by v , the travel time between two locations p_1, p_2 can be defined as $T_{p_1, p_2} = \sqrt{\Delta x^2 + \Delta y^2} / v$.

Our operative decision problem can now be formulated as follows.

Given are the data at the beginning of every planning period:

- a number of storage locations that can be classified as (a) occupied storage locations, (certain coils are assigned to certain storage bins) and (b) free storage locations (that is, no coils are assigned to these storage bins),
- a distribution that describes the arrival time of the single incoming orders in the planning period,
- the current position of the automatic transport device (crane),
- the set of coils to be retrieved, whereby the retrieval sequence for these coils can be prescribed (corresponding to the known pickup order for customers or trucks).

متن کامل مقاله

دریافت فوری ←

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