

O.R. Applications

Scheduling of inbound and outbound trucks in cross docking systems with temporary storage

Wooyeon Yu ^a, Pius J. Egbelu ^{b,*}

^a *Department of Industrial and Systems Engineering, Myongji University San 38-2 Namdong, Yongin, Gyeonggi-Do 449-728, Republic of Korea*

^b *Department of Industrial Engineering, Louisiana State University, Baton Rouge, LA 70803, USA*

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Abstract

Cross docking is a warehouse management concept in which items delivered to a warehouse by inbound trucks are immediately sorted out, reorganized based on customer demands, routed and loaded into outbound trucks for delivery to customers without the items being actually held in inventory at the warehouse. If any item is held in storage, it is usually for a brief period of time that is generally less than 24 hours. This way, the turnaround times for customer orders, inventory management cost, and warehouse space requirements are reduced. One of the objectives for cross docking systems is how well the trucks can be scheduled at the dock and how the items in inbound trucks can be allocated to the outbound trucks to optimize on some measure of system performance. The objective of this research is to find the best truck docking or scheduling sequence for both inbound and outbound trucks to minimize total operation time when a temporary storage buffer to hold items temporarily is located at the shipping dock. The product assignment to trucks and the docking sequences of the inbound and outbound trucks are all determined simultaneously.

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1. Introduction

In today's distribution environment, the pressure is on to make the operations more efficient. Companies are cutting costs by reducing inventory at every step of the operation, including distribution. Customers are demanding better services, which translate into more accurate and timely shipments. One innovative warehousing strategy that has great potential for controlling the logistics and distribution costs while simultaneously enhancing the level of customer service is cross docking (Apte and Viswanathan, 2000).

The operation of a distribution center consists of five basic functions: receiving, sorting, storing, retrieving and shipping. If the way these five operations are performed is improved, costs can be reduced and

* Corresponding author.

E-mail address: pegbelu@eng.lsu.edu (P.J. Egbelu).

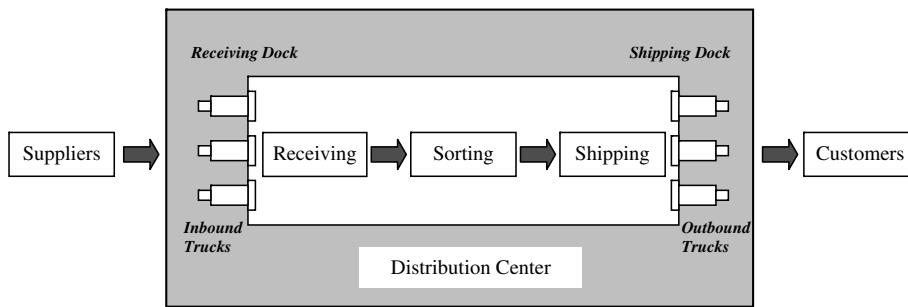


Fig. 1. Typical flow in a cross docking system.

productivity can be improved. However, the best way to reduce cost and improve efficiency is not by simply improving a function but by eliminating it if feasible. Cross docking has the potential of eliminating storage and retrieval, the two most expensive warehousing operations.

Cross docking is a material handling and distribution concept in which items move directly from receiving dock to shipping dock, without being stored in a warehouse or distribution center. In a typical cross docking system, the primary objective is to eliminate storage and excessive material handling.

Fig. 1 shows the flow of materials in a typical cross docking operation. As shown in the figure, the cross docking system generally operates as follows:

1. Products (packages, boxes, cartons, etc.) arrive at the distribution center and are scanned and verified at the receiving docks. In some cross docking systems products are also weighed, sized and labeled at the receiving dock.
2. Products are placed on the sortation systems, which sort by destinations.
3. Products are processed to the proper location on the shipping docks and leave the distribution center.

In general, cross docking works best for companies that distribute large volumes of merchandise and/or serve a large number of stores. Cross docking systems handle a high volume of items in a short amount of time. The advantages of cross docking systems include increased inventory turnover, thus reduced inventory, increased customer responsiveness, and better control of the distribution operation.

To implement cross docking successfully, both hardware and software must be simultaneously considered at the design stage to ensure proper system integration. Hardware such as material handling devices and sortation systems is seeing increased computer control and integration throughout logistic networks. By the very nature of cross docking operations, computer applications are essential and as advances are made in computer technology, such advances are being reflected through innovative technology applications in supply chain systems. Therefore, most of the required hardware for a cross docking system is available today. Meanwhile, software is relatively less developed, though it is as important as hardware to cross docking success. For example, no matter how well the cross docking system is designed, it is still necessary for someone to coordinate the inbound and outbound trucks to the appropriate docks in the appropriate sequences. Improper sequencing of inbound and outbound trucks at the docks increases operation completion time.

In this research, one area of the operational management of a cross docking system is targeted. The targeted area is the docking sequences of the inbound and outbound trucks to the receiving and shipping docks in order to minimize total operation time or in order to maximize the throughput of the cross docking system. The product assignments from the inbound trucks to the outbound trucks are also decided upon simultaneously, along with the docking sequences of the inbound and outbound trucks.

2. Literature review

In published literature, global companies such as Wal Mart (Gue, 2002), UPS (Forger, 1995), and Toyota (Witt, 1998) have reported the successful implementation of cross docking systems. Nevertheless, relatively

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