Chapter II
Dynamic Transshipment in the Digital Age

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ABSTRACT

In recent years, e-retailing has become the growth engine for the retailing industry. A large online retailer usually has multiple distribution centers serving different geographical regions. This chapter explores how to handle transshipment among distribution centers in a geographically dispersed network. We investigate transshipment strategies in a continuous review system with dynamic demand. We present a dynamic program that identifies the optimal transshipment rule. However, the dynamic program is time consuming and might be difficult for practitioners to implement. Therefore, we propose three distinct heuristic decision rules for making transshipment decisions. By employing numerical experiments, we analyze simulated results through various combinations of demand rates and delivery costs. We provide comments and suggestions based on the comparative results generated from different decision rules. As a result, we identify a good heuristic rule, which can be conveniently implemented and used in practice to determine effective transshipment policies.

INTRODUCTION

Nearly two-thirds of all North American households have purchased online. Although the majority of retail sales still take place at traditional brick-and-mortar stores, online sales over the next five years are expected to grow at a compounded annual growth rate of 14% (Forrester, 2005). The fast growth rate of Internet retailing provides new challenges for management.

Online customers need not to care from where their orders are physically shipped. Consequently, many Internet retailers can improve service and reduce expected delivery cost by transshipping between distribution centers. Especially for large online retailers with extensively dispersed networks, the use of transshipments has a significant benefit by redistributing inventories among multiple distribution centers (DCs) (Maltz, Rabinovich, & Sinha, 2004). However, such a practice will incur additional transportation cost in comparison to shipping from its local DC. On the other hand, issuing transshipment will also reduce the ability of the source DC to meet its own local customer demand. In the following, we will use Amazon.com to illustrate a transshipment scenario.

Amazon.com, one of the most successful pure Internet retailers, has grown from a book reseller to a retailing giant on the Internet. Amazon.com reported its net profit in 2005 as $359 million on $8.49 billion in net sales (Finfacts Team, 2006). From its humble beginnings using one distribution center in Seattle, Amazon.com has expanded to seven distribution centers across the United States as listed in Table 1.

Although there are a total of seven DCs, two of them are located in the same state. So according to their physical locations, we can roughly divide the continental U.S. into six different service regions (Figure 1).

Suppose that a customer from Atlanta places an order at Amazon.com; however, the local DC at McDonough, Georgia, is already out of stock. Apparently, this customer demand cannot be directly satisfied from the local DC. Now the question arises: how should the Amazon.com DC operations manager transship the product—ship it out from Kansas, Kentucky, or even from Seattle? The naive solution adopted by most practitioners would be to transship that item from the nearest DC. However, our analysis shows that under some circumstances, this frequently used technique

Table 1. Physical location of Amazon's DCs

DC Locations	DC Targeting Region	Market Number
(1) Seattle, Washington	Northwestern U.S.	1
(2) New Castle, Delaware	Northeastern U.S.	2
(3) Fernley, Nevada	Western U.S.	3
(4) Coffeyville, Kansas	Midwest and Southwest U.S.	4
(5) Campbellsville, Kentucky	Midwestern U.S.	5
(6) Lexington, Kentucky	Midwestern U.S.	5
(7) McDonough, Georgia	Southeastern U.S.	6