Chapter 7
Investigating Strategic Alternatives for Improving Service in an Inland Waterway Transportation System

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ABSTRACT

A series of five locks form a transportation bottleneck in the upper Mississippi River navigation system. With optimizing models, statistical modeling and computer simulation, the authors explore the effects of alternative scheduling regimes and infrastructure changes to improve performance of an inland waterway transportation system. In this paper, the authors show the value of triangulating and integrating analysis with different research paradigms in order to explore the effects of alternative strategies for improving performance of a major transportation system.

INTRODUCTION

The Upper Mississippi River (UMR) navigation system is a critical segment of the U.S. inland waterway transportation system. It extends 663 miles from Minneapolis, Minnesota, southward to the confluence of the Mississippi and Missouri

Rivers near St. Louis, Missouri, and serves as a transportation artery for over 70 million tons of cargo annually (U.S. Army Corps of Engineers (USACE), 2004). The cargo is transported in barges that are lashed together in various patterns and pushed by a single powered vessel (tow boat, or TB). Just north of St. Louis, there is a series of five 600-foot locks (numbered 20, 21, 22, 24, and 25 in Figure 1) located between a pair of 1200-foot

Figure 1. The Upper Mississippi River Navigation System
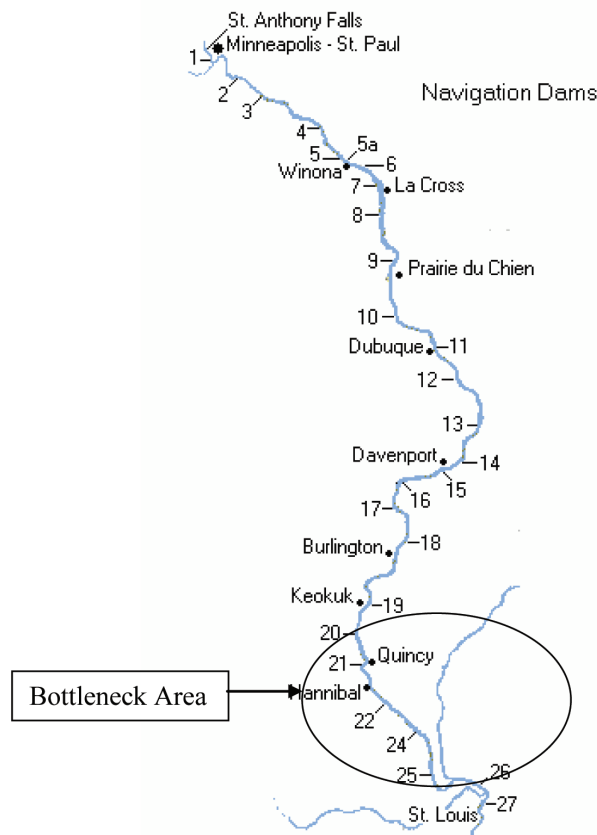
locks (numbered 19 and 26) with greater service capacity. The five smaller locks form a seasonal transportation bottleneck.

The locks are surrounded by different terrain and river conditions that affect the efficiency with which they can process the various configurations of barge tows. Further, they each experience different mixes of traffic. Vessels are processed at the locks using a first-come, first-served (FCFS or FIFO) policy, but some priority is granted to commercial vessels without barges and to recreational vessels. These types of vessels can usually be locked quickly between commercial vessels with large barge tows without causing inordinate delays for the latter. Under extreme operating conditions, the nominal FIFO policy may be waived with the agreement of commercial

tow operators, and tows may be processed through a lock in sequences that allow local synergy to be achieved in the positioning, locking and clearing of queued vessels.

The Water Science and Technology Board of the Transportation Research Council at the National Academies of Science (2004) recommended that alternative traffic management policies be studied as a means of relieving the seasonal congestion in this section of the river. Alternative scheduling mechanisms have been shown to increase throughput in job-shop scheduling and other business environments (Naor, 1969; Su & Zenios, 2004; Rose, 2001; Nong et al., 2005). Ronen et al. (2003) postulated that better utilization of the UMR resources and improved services to commercial users could be achieved

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