WATERWAYS AS A SYSTEM FOR OPERATIONS AND PLANNING

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The characteristics of inland navigation and the purpose of various types of improvements to river navigation are described briefly. A newly implemented performance monitoring system of data collection is explained in some detail. How the operation of waterways influences the design of future improvements is also described.

•THE inland navigation system of the United States consists of approximately 25,000 miles (40 000 km) of navigable channels, 15,000 miles (24 000 km) of which are 9 ft (2.7 m) or more in depth. The Mississippi River and its tributaries constitute the majority of this system (Figure 1). About 1,800 firms use these waters as a means of livelihood, and they transport more than 560 million tons (494 million metric tons) of commerce by shallow draft vessels throughout the United States each year. The average distance shipped by water has increased 20-fold over the past 40 years; the maximum tow size has increased from 5,000 tons (4500 metric tons)/tow to approximately 50,000 tons (45 000 metric tons)/tow.

A tow consists of a towboat and a number of barges held together by a series of tightly winched cables. The typical barge measures approximately 35 by 195 ft (10.7 by 59.4 m), has a draft of 9 ft (2.7 m), and can hold between 1,200 and 1,500 tons (1080 and 1350 metric tons) of commerce. This is equivalent to the amount carried by 25 to 30 average rail boxcars. Tows on the Mississippi River with more than 15 barges normally restrict their operation to below St. Louis because of the dams and channel constraints on the upper Mississippi River and most of its navigable tributaries. However, even a 15-barge tow when fully loaded can carry approximately 20,000 tons (18 000 metric tons) of cargo.

The U.S. Army Corps of Engineers has had the responsibility for the development, maintenance, and operation of U.S. inland waterways since about 1824. The job of caretaker to these waterways is not simple. The task of satisfying the demand for all modes of transportation is straining all sectors—rail, barge, truck, and pipeline. In the absence of expanded and more efficient transportation facilities, the cost of all modes must rise. In the long run, the ability to consider one form of transportation over another may be less relevant than the ability to transport at all.

The Corps of Engineers has several ongoing programs by which they hope to maximize the operating efficiency of the waterways and optimize the design and scheduling of future improvements. Using the navigation lock and dam is one of the most common methods by which a waterway may become navigable. The purpose of these structures is to maintain depth that is adequate for commercial tows to navigate. Usually a depth of 9 ft (2.7 m) is ensured. Excess water is released by means of tainter gates in the dam. To permit the tow to pass from one pool on the river to another, locks are built into the navigation dam. After they are placed in operation, a navigation lock and dam are expected to remain in service for 40 or 50 years.

As the costs to construct these projects increase (some cost more than $200 million), the need to operate present facilities as efficiently as possible becomes even more essential. Also delays at a dam cost a shipper about $100/h/tow; on long transits this can add significantly to the cost of a shipment. This cost usually will be passed on to the final consumer of the product. Better operating efficiency means fewer delays, the ability to postpone costly structural improvements, and, in the long run, reduction in the overall cost of transportation.

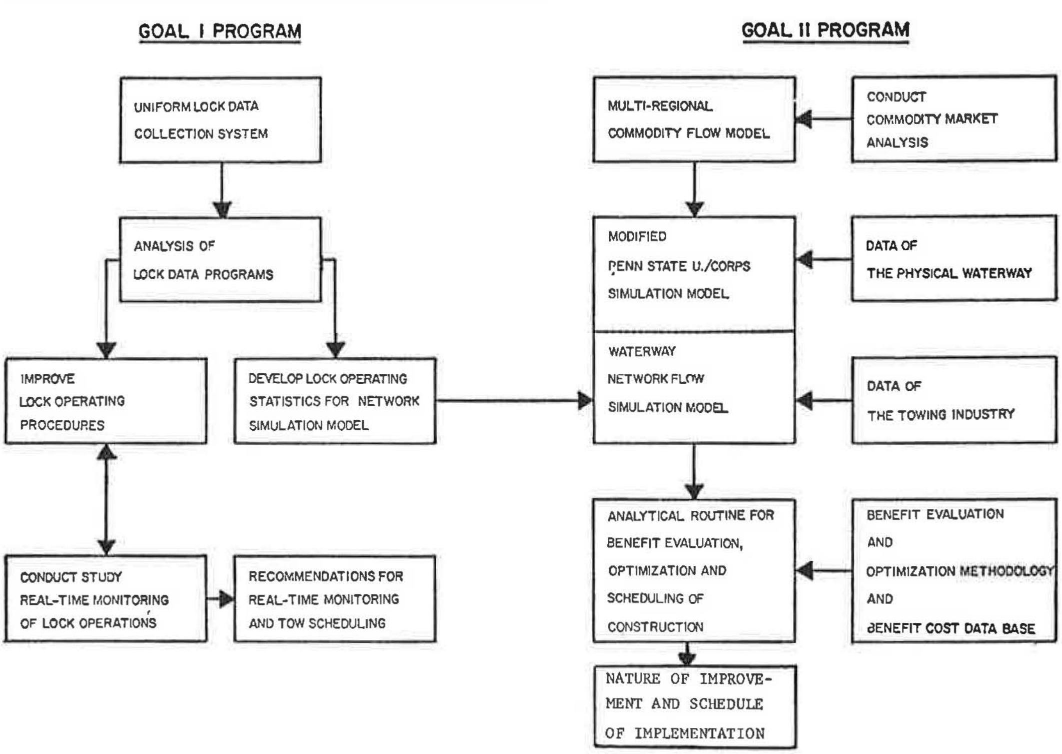
As part of our effort to maximize the operating efficiency of the waterway and optimize the design of future improvements, a new data collection system is being im-

Figure 1. Inland waterways system of the Mississippi River and tributaries.

plemented at each of the 256 locks operated by the Corps of Engineers. Information on the nature of traffic, weather, waterway conditions, delays, and lockage characteristics can for the first time be collected uniformly and compared with operations at other locations. Some of the initial computer programs have already been written and will be in use by the end of April 1975. This performance monitoring system should provide us with much valuable information for the planning of future waterway improvements and more efficient operation of present facilities. For example, monthly statistics by type of commodity on the amount of commerce that passes each lock will be collected. The level of lock use and delays experienced at each lock will be measured. Hourly traffic levels also can be analyzed. The length of time it takes a tow to make a lockage under various operating conditions is of primary interest. An early study will include an analysis of lockage times at various geographic locations to understand why a certain type of lockage at one location takes 30 min and at a different location it takes an hour. Similar studies have been made at single locations, but these studies have never been done nationwide. Where operating improvements can be identified, they will be implemented.

Every user of the inland waterways, including the Corps of Engineers, must operate as responsibly and efficiently as possible. The performance monitoring system will aid in identifying less-than-efficient operations and, hopefully, will lead to their improvement. In addition, the system will indicate which portions of the waterway are most heavily used. A great deal about the nature of future traffic may also be learned. Data from the performance monitoring system will be analyzed and combined with information on various physical characteristics of the waterway. The characteristics of the waterways, bridges, bends, and channels, as well as those of the commodities shipped, can aid in the analysis and projection of future traffic. This, in turn, will influence the design of future navigation improvements and determine when they will be needed.

Figure 2. Overview of inland navigation systems analysis.



For several years now the Corps of Engineers has been active in the development of new methods by which to improve the operating efficiency of the inland waterways of the United States and the planning of future improvements. In addition to the performance monitoring system that I have described briefly, the Corps of Engineers is engaged in a $1 million program that can analyze simultaneously all of the navigation components of the Mississippi River system (Figure 2). This research includes a commodity market analysis of those products that can be moved by barge to better understand the nature of these commodities. The market analysis is an extension of the study done for the Maritime Administration (1) and is intended to supplement a multiregional commodity-flow model of the markets serviced by the inland waterways of the United States. The purpose of this commodity-flow planning tool is to give the Corps of Engineers the ability to evaluate alternate economic plans and estimate the effects of each of the 4 transportation modes (special attention is given to inland navigation). For example, the potential market shifts in supply and demand caused by the development of the coal deposits in the western United States can be evaluated.

A sophisticated computer simulation and optimization model is also being developed to be the central part of the analysis of the inland waterways navigation system. It will take data on commodity flows, characteristics of each transportation mode, and other data on the locks and waterways and evaluate the capability of each mode to meet projected demands. This computer model then will evaluate which alternative waterway improvements are needed and rank them in accordance with their contribution to the navigation system. The Corps of Engineers has been moving toward the capability for total systems analysis for nearly 5 years. Some of this work has been completed successfully; however, in applied research there is always the risk of failure.

REFERENCE

1. A. T. Kearney, Inc. Domestic Waterborne Shipping Market Analysis. Maritime Administration, U.S. Department of Commerce.