In addition, projections show that 5% inflation on projects will outrun the 1.5% increase in fuel consumption. While some elements of the government wish to use the Trust Fund for rehabilition, the Board will oppose such use in order to maintain solvency of the fund for new projects.

Today, the waterways are basically sound and efficient, although parts of the system are not operating at maximum efficiency because of downtime. The Board believes that the advent of the new cost sharing relationship with the government, users, and shippers will be able to help the Corps evaluate components of the system in order to maximize the best use of our limited financial resources, by directing those resources where they are needed the most. Our goal is that the Board will play an important role in establishing an order of procedure to ensure that projects are studied, rehabilitated, or replaced in a timely manner and with a good return for the investment in the system. The Board has already made progress toward that goal. I believe that the Board and the Corps have learned a great deal from each other. As the IWUB matures and learns, it will achieve the results that were intended by the Congress.

UPPER MISSISSIPPI RIVER TRANSPORTATION ECONOMICS STUDY

BY
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The upper Mississippi River Transportation Economic Study is a cooperative effort between five states and two federal agencies--the U.S. Maritime Administration, U.S. Department of Agriculture and the Departments of Transportation of the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The study is investigating the short-term alternatives to the costly infrastructure investments on the Upper Mississippi River. "Upper Mississippi" is defined as the area from Cairo to just north of the Twin Cities. The objective of the study is to identify, test, and analyze relatively low-cost, practical measures that will improve the cost structure of transportation on the river. A product of the study will be a micro-computer based model which can be applied in analyzing other waterway systems as well.

The Impetus Behind the Study

The Upper Mississippi River is an important link in the transportation of bulk commodities which are vital to the Midwest economy. Low transportation costs are essential in maintaining the competitiveness of Midwest grain exports, as well as controlling the cost of regional energy. The current system of 26 locks imposes high capital and operating costs on barge operators due to lock and navigation constraints. The recent increases in user fees, together with deteriorating infrastructure conditions further detract from the cost efficiency of the system.

Federal funding is unlikely to provide relief in the near future. There are currently no major infrastructure improvements budgeted for the Upper Mississippi River other than the current construction at Lock and Dam 26.

Similarly, the depressed state of the inland barge industry makes it impossible for operators to subsidize capital projects. Therefore, near-term cost savings will have to result from improvements in the utilization of the current system. To respond to these concerns, the five states formed a Study Committee, retained a consultant to assist in developing a study plan and funding requirements, and then went to MARAD and USDA for funding assistance. The project began in August 1986 and is scheduled for completion by October 1988.

Study Phases

The study has five phases:

Phase 1: Metodologies, forecasts and data

a. Identification and evaluation of various methodologies, forecasts, data and information sources which might have application to the study. The product of this phase is an extensive bibliography.

b. Formation of an Industry Advisory Group, comprised of representatives of major carriers and shippers in the region. This group assisted the study team by providing data relating to their operations, and by generating feedback on various interim study findings.

Phase 2: Identification and preliminary screening of potential efficiency measures. These measures fall into four general categories:

a. Tow Efficiency Measures: Those which affect the productivity of individual tows and include advancements in towboat, barge, barge transfer or fleeting technology, which improve productivity and efficiency on the system--examples include fuel monitoring systems and new barge/hull designs.

b. Waterway Efficiency Measures: These measures include low-cost changes to the physical waterway system which would relax constraints or improve efficiency. These include non-structural and minor structural measures such as real-time channel depth monitoring.

c. Vessel/Barge Management Measures: These are improved management techniques aimed at achieving more rationalized service or improved pricing and marketing, such as improved communications and scheduling and cooperative barge fleeting.

d. Public Management Measures: These include examination of alternative dredging practices and/or water management policies which could influence transportation costs and channel reliability. The 1988 drought resulted in requests that water be diverted from the Great Lakes to the Mississippi to maintain a navigable waterway.

Phase 3: Interactive computer model

The model is based on relational databases which represent the waterway's operating and cost characteristics under base and forecast scenarios. The

model links these databases through individual software modules used to estimate and summarize waterway activity, system costs, and system impacts for the current database values. The efficiency measures are evaluated by comparing the model's output for the base and test sets of data values.

a. The primary databases used to represent the current and projected status of the waterway system include:

- Waterway Characteristic Database--the physical and tow operating characteristics for individual river segments, as defined within the database using river-mile points;

- Lock Characteristic Database--physical, tow operating and processing time/delay elements for locks described by mile locations;

- Equipment Characteristic Database--operating capacity and cost characteristics for various categories of barge types and towboat sizes;

- Commodity Characteristic Database--average load and forecast growth factors for defined commodity groupings;

- Commodity Flow Database--base segment-to-segment flows for defined commodity and barge groups.

b. The system modules which link and process the data include:

- Database Manager to enter and edit primary databases.

- Waterway Activity Generator to convert commodity flows for selected time periods into seasonal segment and lock throughputs by equipment type and direction.

- Lock Unit Resource Calculator to generate seasonal lock processing and delay functions for projected throughput under "active" lock conditions and traffic patterns.

- Segment Unit Resource Calculator to estimate weighted cost and time factors by season, tow type and river segment based on traffic distributions and described channel operating conditions.

- Resource Allocation Module to allocate and assign unit transportation time and cost factors by equipment type for individual traffic flows.

- Tow Power Calculator to estimate required horsepower hours and fuel consumption for active speed, segment and towboat/barge characteristics.

- Efficiency Measure Tester to alter appropriate database values for a selected measure or set of measures and compare the estimated system costs and impacts to base cost estimates at a system or micro level.

The open-ended database structure will allow the model to be applied to other waterways by customizing the databases (with local data) without altering the model structure. The level of detail required for each application can be determined by the user, not the model structure. The modular software structure allows individual sections of the model to be replaced or refined without re-designing the entire model. Additional modules can also be added in the future.

Phase 4: The actual application of the model and the analysis of the results, which leads to

Phase 5: The final assessment and evaluation of the measures and preparation of the final report.

The impact of the efficiency measures can be measured at two levels:

- The micro impact of the measure evaluated by comparing transportation cost and time estimates for individual tow movements.

- The system impact measured by differences in total system demand and impact, as well as system costs.

Study Problems

Some of the problems that have been encountered in this study include:

Data Availability and Collection Problems:

- Lock-oriented PMS system concentrates on capacity of locks, not efficiency of channel operations.

- Lack of representative physical river characteristics made it difficult to "model" relationships with tow operations.

- Operator cost and operating data are on a system basis and not closely related to conditions to be improved with efficiency measures.

Modeling Methodology Problems:

- Attempting to represent a highly dynamic system under static conditions--we used detailed distributions and relationships to isolate "measure-related" conditions.

- A vast array of highly variable characteristics, many of which are interrelated, made it difficult to reconcile data variations with model calibration.

- "Average" representations of characteristics such as tow size and river conditions were not accurately portraying irregular distributions--We used high, medium and low distribution patterns to resolve this.

- Traffic flows "react" to system characteristics based on both a trip (e.g., maximum draft) and segment/node basis (tow operating speed). The model structure assigns certain characteristics on an origin/destination basis and then estimates individual segment/node factors using weighted values for these characteristics.

- Attempt to incorporate all possible efficiencies from tow operations to system management resulted in too complex a specification.

Model Features

In summary, the interesting features of the model include:

- applications of segment characteristics on both a trip and individual basis.

- individual flows and allocated cost and time factors based on commodity, barge, tow type (unit/mixed), and the specified combination of segments.

- rudimentary distribution functions (high, medium, low) more closely relate to actual distributions and permit different "reactions" to system conditions.

- equipment flows are balanced on an annual basis, but loaded and empty flows are allocated separately by season using weighting factors.

- lock delay calculator incorporates detailed representations of lock processing functions and operating procedures directly related to efficiency measure definitions. Estimated "non-scheduled" delay can be related directly to reduced tow speeds in lower and upper pools.

The consultant and others on the study team (as well as the Study Committee) will admit that the entire effort has been far more complex and challenging than anyone had envisioned at the outset. However, the final product will serve as a valuable tool in future inland waterway planning efforts.

The final report will be available through the Iowa Department of Transportation in late 1988. The software and documentation will be available through the Maritime Administration.

MIDDLE COLUMBIA RIVER STUDY
SHIP LIFT ALTERNATIVES

BY
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This paper summarizes the options for opening up the Middle Columbia River from Richland to Wenatchee, Washington, for navigation and commerce (See Figure 1).