# Reliability of Commodity Freight Projections for Inland Waterway Ports

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**Feasibility studies recommending construction of ports, terminals, or industrial complexes along U.S. inland waterways rely heavily on projections of commodity freight. Tabulated results of projections versus realized results obtained from 12 ports on the inland waterways navigation system indicate that projections of commodity freight made in connection with port development have almost always been too low. Reliable projections of freight by commodity classification are essential in physical port planning, and projections of the amount of freight can be helpful when they indicate a median projection and a stated wide variation above and below that median.**

Inland waterway port planning has invariably been based on projections of commodity freight. The use of such projections in benefit-cost justification of inland waterway or canal development dates from the early years of this century, and their use to justify the navigation aspect of a single inland waterway port and waterfront industrial park dates from the end of World War II. At least one case has been examined of actual use versus initial projections for a waterway or canal that had been in use for several years. To our knowledge, however, no such examination has ever been done for individual ports.

This paper investigates the reliability of freight projections for inland waterway ports by examining 12 ports along the Mississippi River system. The objective is to provide answers to the following questions:

1. If projections were made, how reliable have they been?
2. What general range of reliability is required?
3. To what source would the experienced port operator look today for reliable data on which to base projections of commodity freight?
4. Is more detailed investigation justified?

## QUESTIONNAIRE

A questionnaire (Figure 1) sent to the directors or managers of 12 inland waterway ports was designed to test the reliability and usefulness of commodity freight projections as a tool in planning waterfront facilities and associated industrial parks. Although the questionnaire was not to be used as a planning and justification tool for navigation improvements, as it frequently is in the case of U.S. Army Corps of Engineers projects for individual ports and related harbors, Corps of Engineers figures proved to be the only ones available for the oldest existing inland waterway ports and were therefore used.

There was a 100 percent response from the 12 port directors contacted. Some responses were detailed, some required further research, and some provided only sketchy information. There was no time to repeat inquiries or to request further information; this, along with other factors, resulted in our decision not to identify the ports involved. Table 1 gives a summary of the responses to the questionnaire.

### Diversity of Ports

The 12 ports responding to the questionnaire were all on the Mississippi River system: three on the free-flowing (lower) Mississippi, four on the Ohio River system, three on the Arkansas River system, and two on the upper Mississippi system. All except the three from the lower Mississippi River were in lock and dam river areas. The oldest port had opened its doors to business in 1952, the newest in 1975. (Only projections for substantial improvements were considered for ports in locations that had continuing histories of waterway transportation activity, which in some cases extended back more than a century.) The gross size of port and waterfront industrial areas ranged from 121.4 to 283.3 $km^2$ (30 000 to 70 000 acres). Systems of organizational control included private, city, county, city-county, and state. Financing methods for landside and waterfront facilities and industrial land sale or lease activities included private, city, and county general obligation bonds, revenue bonds, direct city and county funds, a variety of state taxing and bonding assistance, and various types of federal assistance including recent revenue sharing.

### Realized Versus Projected Activity

After establishing the year in which the last projections were made (before the port opened for business or substantial improvement) and requesting information about who made the projections and what method was used, we posed the central question: What is the reliability of river-port commodity freight projections? The responses were reduced to a ratio of actual to projected reliability (Table 1). Information was also requested on actual versus projected sale or lease of industrial lands, and six positive responses were received. There were no useful responses to a request for information on actual versus expected phasing of public terminal expansion.

### Utilization of Resources

The surveyed ports were asked to indicate (a) whether, as a result of port projections, resources had been expended for facilities that were never used and (b) whether resources that should have been expended were not because of incorrect projections. Only two respondents completed that section, and both answered in the negative.

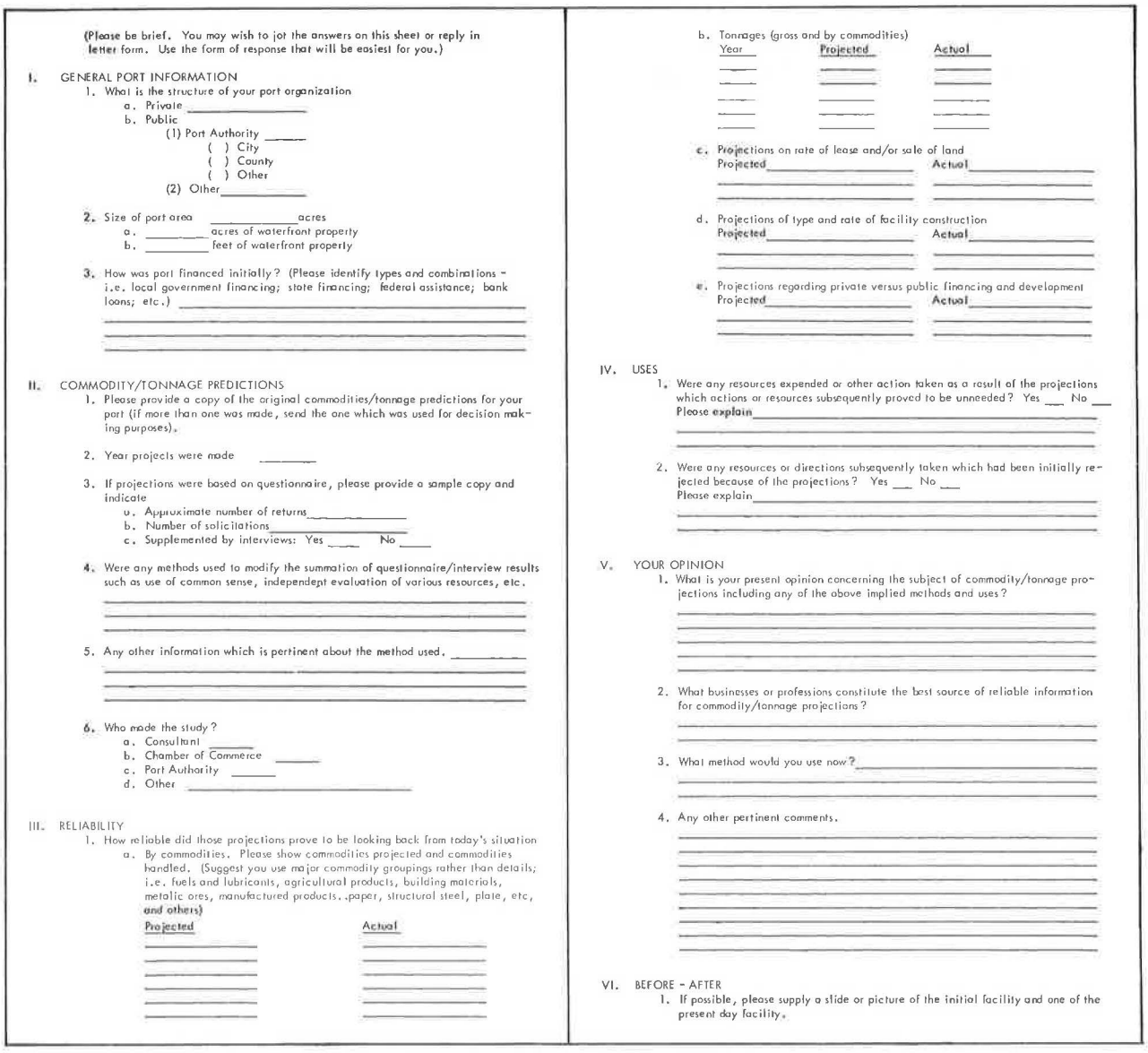
### Opinions

Statements of opinion were requested. Eight of the 12 respondents gave such statements.

## RESULTS

A wide range of responses to the questionnaire had been anticipated. The actual response to critical questions was about 40 percent, with different respondents participating on different questions. Because the subject matter

**Figure 1. Inland waterway port questionnaire.**



(Please be brief. You may wish to jot the answers on this sheet or reply in letter form. Use the form of response that will be easiest for you.)

I. GENERAL PORT INFORMATION

1. What is the structure of your port organization
   a. Private _____
   b. Public
      (1) Port Authority _____
          ( ) City
          ( ) County
          ( ) Other
      (2) Other _____

2. Size of port area _____ acres
   a. _____ acres of waterfront property
   b. _____ feet of waterfront property

3. How was port financed initially? (Please identify types and combinations - i.e. local government financing; state financing; federal assistance; bank loans; etc.) _____

II. COMMODITY/TONNAGE PREDICTIONS

1. Please provide a copy of the original commodities/tonnage predictions for your port (if more than one was made, send the one which was used for decision making purposes).

2. Year projects were made _____

3. If projections were based on questionnaire, please provide a sample copy and indicate
   a. Approximate number of returns _____
   b. Number of solicitations _____
   c. Supplemented by interviews: Yes ___ No ___

4. Were any methods used to modify the summation of questionnaire/interview results such as use of common sense, independent evaluation of various resources, etc.

5. Any other information which is pertinent about the method used. _____

6. Who made the study?
   a. Consultant _____
   b. Chamber of Commerce _____
   c. Port Authority _____
   d. Other _____

III. RELIABILITY

1. How reliable did those projections prove to be looking back from today's situation
   a. By commodities. Please show commodities projected and commodities handled. (Suggest you use major commodity groupings rather than details; i.e. fuels and lubricants, agricultural products, building materials, metalic ores, manufactured products. .paper, structural steel, plate, etc, and others)

| Projected | Actual |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

   b. Tonnages (gross and by commodities)

| Year | Projected | Actual |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

   c. Projections on rate of lease and/or sale of land
      Projected _____ Actual _____
   d. Projections of type and rate of facility construction
      Projected _____ Actual _____
   e. Projections regarding private versus public financing and development
      Projected _____ Actual _____

IV. USES

1. Were any resources expended or other action taken as a result of the projections which actions or resources subsequently proved to be unneeded? Yes ___ No ___
   Please explain _____
2. Were any resources or directions subsequently taken which had been initially rejected because of the projections? Yes ___ No ___
   Please explain _____

V. YOUR OPINION

1. What is your present opinion concerning the subject of commodity/tonnage projections including any of the above implied methods and uses?
2. What businesses or professions constitute the best source of reliable information for commodity/tonnage projections?
3. What method would you use now? _____
4. Any other pertinent comments.

VI. BEFORE - AFTER

1. If possible, please supply a slide or picture of the initial facility and one of the present day facility.

**Table 1. Responses to the questionnaire.**

| Port | Organizational Control | Size[a] | Year of Projection[b] | Year Port Opened[b] | Reliability Ratio[c] Commodity Classes | Reliability Ratio[c] Annual Freight | Land Sale or Lease |
|---|---|---|---|---|---|---|---|
| A | City-county | 2 | 1966-67 | 1968 | 6:4 | 4:1 | All costs recovered, 60 percent unsold |
| B | Private | 2 | 1975 | 1975 | Unknown | Unknown | 5 to 10 years |
| C | City | 3 | 1962 | 1969 | 5:5 | 1:1 | Projected exceeded actual |
| D | City | Unknown | Unknown | Unknown | Unknown | Unkown | Unkown |
| E | Private | 1 | 1971-72 | 1974 | 4:4 | 3:1 | NA |
| F | City-county | 3 | 1964 | 1971 | Unknown | <1:1 | 14:15 |
| G | County | 2 | Unknown | 1959 | Unknown | 3:1 | 20:8 |
| H | County | 1 | 1955 | 1958 | Unknown | 10:1 | 5:3 |
| I | City-county | Unknown | Too recent | — | — | — | — |
| J | City-county | Unknown | Too recent | — | — | — | — |
| K | City-county | 3 | 1945 | 1952 | Unknown | 40:1 | Not projected |
| L | State | Unknown | None | | | | |

Note: 1 km² = 247.1 acres.

[a] 1 = <0.4 km²; 2 = 0.4 to 4 km²; and 3 = >4 km².

[b] Applies in some cases to major port improvement rather than port opening.

[c] Actual divided by projected.

does not lend itself to selective sampling from among a large number of respondents, the usual methods of statistical sampling analysis could not be applied. On the other hand, the approximate 40 percent response (in some cases, much more) to critical questions did have a consistency that offset the small sample size. There is evidence that a more intense investigation might change certain specifics of the responses but would not change their general nature.

### Diversity

The greatest number of port organization structures were combined city and county, with most of the remaining ports being city only or county only. Private control and state control were exceptions. [Private control refers in this paper to privately owned public (general-purpose) terminals and associated lands and not to private ownership or privately controlled special-purpose terminals or riverfront industry terminals.] Enough information was supplied in each category to support the conclusion that the reliability of projections is essentially the same regardless of the type of organizational control or the size of the port facility.

In the formulation of projections, the age of a port is a general indicator of its degree of sophistication, the oldest ports being the least sophisticated. At the oldest of the ports we surveyed, local civic leaders used projections principally to justify navigation improvements by the federal government. Projected freight appeared as a single gross item in the federal project report, and there was no indication of the years to which the projection might apply or the types of commodities involved. These responses did not indicate whether freight projections were subsequently used in planning, phasing, layout, or design of landside facilities.

It should be noted that the civic and professional leaders who participated in the initial development of these older ports are probably no longer actively engaged in port operations. The fact that the second port-management generation must now research the projection process to obtain and provide answers creates an urgent need for more detailed research. Repeating surveys every 10 years, for example, could ensure getting accurate data from those actually involved in port management during the period surveyed.

Ports under a governmental control structure now consider detailed projections a normal requirement. Many of the more recently used methods of financing for governmentally controlled ports, such as revenue bonds, general obligation bonds, and state and federal development funds, require detailed projections without regard to whether or not these projections are needed in project planning, phasing, design, and construction. Data obtained from private ports indicate that they tend to be informal concerning projections.

### Realized Versus Projected Activity

As previously mentioned, the oldest of the ports used projections of gross freight without indicating classes of commodities. Only three respondents to the questionnaire stated that their port projections included commodity classifications. However, the experience of all three was essentially the same: Reliability for commodity classifications was excellent, ranging from a projected-to-actual ratio of 3:2 to 1:1. Projections of commodity classes are generally quite reliable for the following reasons: (a) They are invariably an easily derived function of local economic conditions, especially concerning commodities that are traditionally susceptible to the economies and benefits of water transportation; and (b) even unexpected increases or decreases in the classification span by one commodity have no major effect on the reliability of a projection stated as a ratio.

All but one respondent indicated that projections of amount of freight had proved to be greatly understated. A federal government feasibility study stated that local decision makers at one of the older ports had projected an annual amount of freight approximately 4 times the amount the government study accepted as accurate. Today the actual annual increase in freight for that port is more than 10 times the federal estimate. Actual versus projected freight ratios on an annual basis ranged from more than 40:1 to 3:1 except in the case of one new port. Freight projections have not generally been reliable. The professional who must make the final projection tends to understate, and properly so. This raises the question, Are detailed freight projections a necessary element of the port planning process?

Most respondents failed to provide useful data on the use of projections in phasing and planning either the original public terminal construction or expansions. Construction of a public terminal is required in most cases where federal assistance has been provided and, once a terminal is constructed, expansions usually follow as a result of successful business activity. Public terminal planning, phasing, design, and construction as well as subsequent expansions appear to derive more from administrative requirements and commodity classifications than from amount of commodity freight. Reliable projections of commodity classifications are therefore important in public terminal planning but accurate, long-term projections of amount of freight are not.

Projections for sale and lease of land are relatively reliable, if we allow for some early years of little activity. The respondents' projections were, naturally, less definitive than those for commodities and amount of freight. Three respondents gave definite figures; their actual projected ratios ranged from 1:1 to $2\frac{1}{2}$:1. Some responses were qualitative, e.g., "all cost recovered with 60 percent of land still unsold."

### Utilization of Resources

Responses were inconclusive concerning overutilization or underutilization of resources because of projections.

### Opinions

Five of the 12 ports furnished no separately written opinions. Three of the remaining 7 listed experience as the best method to use in projections, implying that quantitative processes are at best built on specifics derived nonspecifically. One respondent said simply that "it is difficult to project." Projections into the distant future can be drastically changed by one unforseeable change.

Personal contact was emphasized. Port users and local producers were mentioned twice in the opinions section as good sources of projection data. Chambers of commerce, business people, economists, and the Corps of Engineers were noted as other sources. The use of a questionnaire was listed once as a specific method, but research was listed twice and that word probably included research by questionnaire as well as by other means.

## CONCLUSIONS AND RECOMMENDATIONS

Responses to the questionnaire provided the following answers to the questions originally posed in the study.

1. If projections were made, how reliable have they

been? Projections that included separate commodity classifications proved to be sufficiently reliable for use in planning, initial phasing, design, and construction of facilities. Freight projections were generally much too conservative. Projections on the rate of sale or lease of land have been rare but relatively reliable.

2. What general range of reliability is required? Because the responses offered little useful information on this question, what follows is based on our own personal observations.

Facilities planning usually falls into two distinct categories: (a) public (general-purpose) terminal and (b) associated waterfront industrial park. The public terminal by its nature must be planned for a wide range of commodity classifications and, once the original waterfront facilities are constructed, expansions can rapidly be made to fit unexpected increases in certain commodities. In addition, wharf and mooring capacity usually exceeds other terminal capacity by so much that expansions do not require the per-megagram resources of original design and construction. Projections of amount of freight are more likely to be used to justify financing than to clarify detailed design and planning decisions for the public terminal.

From a planning viewpoint, the related waterfront industrial park resembles ordinary industrial subdividing except that it is also oriented to waterway transport. Both waterfront and nonwaterfront sites are essential. Planning, therefore, is more likely to focus on the sale or lease of the land than on commodity and freight projections, although these projections do constitute a broad indicator. Obviously, then, commodity freight projections need not be very precise from a planning viewpoint. Instead, they should indicate a median projection with a stated wide variation above and below that median, and this should in turn create a demand for physical plans that indicate minimum anticipated development as well as possible expansions.

The question of the general range of reliability required for purposes of physical planning merits additional research, including a larger sampling, more detailed responses, and the construction of a historical base for review at various time intervals.

3. To what source would the experienced port operator look today for reliable data on which to base projections of commodity freight? There appears to be no single reliable source for such data or, if there is one, it has not yet been proved by real-world testing. Port operators did not provide any new answers. Although this is a topic that does not currently merit any additional research, it would be appropriate to ask the question again because port operators are continuously gaining experience and exposure on the front line of the inland waterway transportation industry.

The center of gravity of research in commodity classes and freight projections is invariably national policy and how to influence it. But it is the local decision maker who must use projections because he or she must live within specifically or vaguely stated national policy. Local decision makers need more help than they are getting in this area.

4. Is more detailed investigation justified? We recommend researching a simple system for one federal agency, bureau, commission, association, or business to provide frequently updated box scores on projections. The how, who, what, and where would be part of the research. The initial cost should be low—perhaps $85 000—to encourage simplicity. Funding should be by a nonoperating research organization, one that cannot suggest it assume the updating role following initial research. The project should (a) suggest a format for minimum projection tabulation so that updated box scores can be meaningfully assembled, (b) show singly or in combination the sources of data and opinion that have proved most reliable, and (c) indicate a general range of projection development costs that has proved optimum, perhaps as a percent of project construction costs, to determine whether there is a point at which additional projection costs produce rapidly diminishing returns in the form of useful projections.

# Commodity-Flow and Multimodal Transportation Analysis for Inland Waterway Planning

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**The inland navigation systems analysis program of the U.S. Army Corps of Engineers is an integrated system of models, data, and planning procedures designed to explain, predict, and plan for U.S. inland waterway transportation. The program forecasts future waterway traffic by means of commodity-flow and multimodal network models. The commodity-flow model is similar to a multiregional input-output model with variable coefficients, in which market behavior and transportation costs determine location, composition, pricing, and level of output and the interregional commodity flows derived from them. The multimodal network model allocates these commodity flows to the several modes, based on transportation cost and performance criteria, and the allocations, as applied to the inland waterway system, constitute the waterway traffic forecast.**

The inland navigation systems analysis (INSA) program of the U.S. Army Corps of Engineers (1) is an integrated system of models, data, and planning procedures designed to explain, predict, and plan for U.S. inland waterway transportation and to help planners reach thoroughly examined investment, operation, and maintenance decisions for inland waterways. The models are designed to mimic the national market system and the role of inland waterway transportation within that market system by simulating both inland waterway transportation and transportation markets within the national market system. The purpose of this paper is to describe the models and to explain how they are used to estimate demand for in-