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Contents

Intermodalism and Improved Transportation Productivity

ROBERT A. KYLE

The advantages of and prospects for water-rail movement of bulk commodities are briefly examined. It is concluded that cooperation between water carriers and the railroads will increase sharply in the 1980s as a result of the pressures of inflation, the need to improve productivity and capacity, anticipated cost and fuel savings, and the likelihood that intermodal cooperation will economically benefit both modes.

A whole new dimension to intermodalism has been quietly developing in the past few years and will accelerate to major new proportions in the 1980s. This is the interchange of millions of tons of bulk materials in the coordination of rail and water services.

Railroads are best equipped to handle bulk materials overland in huge volumes over long distances, and water carriers are even better equipped to handle them over very long distances by the river system. The combination of the best efficiencies of railroading and water transportation can and does make possible significant improvement in productivity in the vital and always expensive distribution process. Involved are the very large movements of coal to the electric utilities, food and feed grains for home consumption and for animal and chicken feeds, chemicals and fertilizers, ores of all kinds, and even steel products.

Any increase in the costs of these products produces a major multiplying effect throughout the economy. Reductions in costs at the transportation level of production can play a substantial role in the battle against inflation. I should point out that transportation is a much more significant part of the end cost of bulk raw materials and semifinished products than it is of the cost of finished products.

It is axiomatic that one of the major weapons in the fight against inflation is improvement in productivity--greater efficiency in the use of resources. Many of us are aware that the current figures on productivity trends are showing a sharp and alarming falloff. Where productivity declines anywhere in the pipeline of production and distribution, inflationary forces build up, but particularly menacing is inflation in the early stages of production. And right there is where the water carrier can make a significant contribution.

It is a fundamental law of physics that it takes less effort to move a floated ton than to transport a ton overland. Labor produces far more ton-miles by water than by any overland means. A barge can carry five times its own weight compared, for example, with a freight car, which carries only twice its own weight. A single towboat can push up to 50 000 tons; the same tonnage would require 15-20 locomotives and at least 500 freight cars. A barge takes less effort and costs far less to maintain than the equivalent string of freight cars. The water mode is at least 50 percent more fuel efficient than the most efficient overland mode. Finally, in terms of the cost of expanding capacity, a critical consideration in the inflation battle, the public and private investment required to increase capacity is far less for water than for any overland mode.

So it is important news that a lot of planning is now going into promoting intermodal water-rail movements--promoting the efficient combination of the lowest-cost means of transportation. Heavy investment is going into water-rail transfer facilities, and more investment is on the way. I do not say we have finally overcome the century-old reluctance of some railroads to join water carriers or yet talked the railroads out of participating in the environmental lawsuit on Locks and Dam 26, but there is evidence of some long-range thinking on these issues.

I take an optimistic view, along with some who have studied the potential for an increase in traffic on the river and rail systems. The main economic imperative is the substantial savings in cost that result from combining the best efficiencies of railroads and water carriers on long-distance moves of bulk materials. But there are other imperatives. Railroads are highly fuel efficient, but barges are even more fuel efficient. Combining both modes, where possible, would save precious fuel. Another imperative is capacity. Take away a single bottleneck at Alton, Illinois, and the Upper Mississippi, which now handles 25 millon tons/year, could easily handle 45 million tons/year. The Illinois River system, which now carries 32 million tons, could handle 60 million tons. The Ohio River handled 151 million tons in 1976. Its design capacity is more than 480 million tons, and the bottlenecks are relatively minor.

The Lower Mississippi, of course, has unlimited capacity from St. Louis south, and the Great Lakes system has no visible limit. More intensive use of this unused capacity is by far the most cost-effective means of improving transportation productivity and expanding transportation capacity in the mid-American region for the millions of tons of heavy-loading bulk commodities that now move long distances and, in the future, are expected to move even longer distances.

The river roadbed, of course, renews itself and cannot be worn out by the passage of traffic or time.

Recent studies have assumed a doubling of river traffic by the end of the century. The most recent, a report prepared for 17 mid-American states and the U.S. Maritime Administration, says that river traffic will increase from 440 million short tons in 1976 to more than 900 billion in the year 2000. The carriage of grains, coal, petroleum, fertilizers, and chemicals will experience especially high growth. The report identifies a need for 1000 new terminals along the rivers, which will require local investment of almost $9.5 billion.

A main reason for optimism over the future of inland navigation is simply geography. The Mississippi, Arkansas, Ohio, Illinois, Missouri, and Great Lakes systems serve the industrial and agricultural heartland of the country. Most of the economic activity between the Rockies and the Alleghenies is within practical reach of inland water transportation.

Currently, the major feeders to the rivers are trucks. I predict, however, that in the 1980s the railroads will want to compete for that business more and more and will thus extend the commercial reach of the rivers far beyond the present truck range of 50-100 miles. Many midwest railroads are built on the east-west axis and are natural feeders to the rivers.

If we analyze the economics of rail-water movements, for example, we see substantial advantages for railroads. The increased river traffic will not be diverted from the railroads; it will stimulate increases in rail traffic. Stanley L. Crane, pres-

ident of the highly successful Southern Railway, expects rail-freight ton miles to increase 143 percent by 1990 and rail market shares to increase 24 percent.

Take an east-west railroad like the Milwaukee, the Chicago and North Western, or the Burlington Northern. To reach the grain export markets in the Gulf of Mexico, they must agree with another railroad on divisions of an overall rate. Such an all-rail movement is subject to competition from the river, which is fed by trucks over long distances. There is a competitive ceiling on the all-rail rate. It is very likely, even certain, that the railroad can get a higher rate division by connecting with the barge line than by connecting with another railroad. Such a connecting railroad benefits from the efficiency of river service. Part of the saving is passed on to the shipper, but part is shared by the railroad in higher divisions.

The railroad also makes a higher profit per trip more frequently. Instead of the freight car going all the way to the Gulf and possibly waiting at congested terminals for unloading, it stays on the tracks of the originating line at all times. Use of the freight car is thus under far better control. The car may be loaded four or five times as often, at a higher division, by using the barge connection than by using the all-rail connection. Even when the originating railroad has authority for the entire trip to the south, the same economics of car use make it advantageous to interline with barge lines. Significantly higher use is, of course, the cheapest way to expand capacity.

Just last year, a coal terminal in St. Louis began shipping to a utility in Louisiana western coal that was transported to the river by rail from Wyoming. Federal Barge Lines, Inc., is constructing a similar facility 80 miles south of St. Louis at Cora, Illinois. When completed in 1980, it will be capable of handling 15 million tons of Illinois and western coal. It is certain that this would not have been possible if we had not had the cooperation of some progressive, economically realistic railroad executives.

Most rail-water movements of coal on the Ohio River and from the West to the Mississippi are voluntary within the present basic legal framework, which is intended to encourage rail-water coordination. But there have been situations in which a railroad would refuse outright to join with a water carrier. On those occasions, the railroad saw an opportunity to raise its rate to the port in order to force the traffic to go all rail at a higher cost to the consumer.

Although the law is clear enough and the Supreme Court has said often enough that the railroad has no right, by exploiting its monopoly of the services to the port, to deprive the inland shipper of the competitive rail-water alternative to an all-rail service, we think any new legislation should clarify and solidify this point. A current proposal to the Congress clearly prohibits the practice of squeezing out the water carrier by the artificial manipulation of the rate to the port. It has been suggested that a treble damage penalty be introduced for such tactics. This proposal simply preserves a shipper's right to a competitive alternative. The public is always better off when a competitive alternative is not artificially suppressed.

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Forecasts of Key Commodity Flows at a Regional Port

LONNIE E. HAEFNER, DONALD E. LANG, AND TOM CRONIN

Some practical aspects of forecasting key commodity flows for the Port of Metropolitan St. Louis are heuristically examined. Scenarios of regional economic growth are developed, detailed industrial market studies are assessed, and regressions are adjusted from baseline output to reflect the impact of intermodal opportunities, the needs and demands of target industries, and the unique position of the port below Locks and Dam 26. Key forecasts of flows of cash grains and grain products, coal, petroleum and petroleum products, chemicals, and fabricated metals are examined. Operational problems resulting from growth in commodity flows at the port are identified. Finally, the need for port studies to identify and capitalize on the unique locational and industrial assets of individual regions is discussed.

The objective of this paper is to examine the flows of key commodities into the Port of Metropolitan St. Louis during the current period of shifting energy policy, more intensive import-export programs, and inflationary pressures on industrial expansion. It is important to examine national movements of key commodities such as coal and petroleum in the context of a regional port. Furthermore, it is particularly important to examine them in the context of the St. Louis port because of its strategic location on the national inland waterway system.

The unique characteristics of the Port of Metropolitan St. Louis that are relevant are the following:

1. In terms of tonnage, it is the largest inland port on the system.
2. It is crucially placed just below Locks and Dam 26 at Alton, Illinois, and thus acts as a nodal point on the river for tow sorting and makeup.
3. It interacts with a large midwest rail network and so is capable of acting as a test-bed for potential rail-water cooperation.
4. It lies at the edge of the midwest corn and wheat belt and acts as the metropolitan starting point for much of the agricultural movement of products destined for international distribution.

In light of the above, altered construction at Locks and Dam 26, user-charge mechanics, and trade policies will be felt in commodity flows and interchanges at the St. Louis port. The balance of this paper presents a detailed and regionally refined set of commodity-flow forecasts and a discussion prepared for a local port district study now under way.

REGIONAL SCENARIOS

To facilitate the understanding of origin-destination and commodity-flow levels in the St. Louis bi-state region, a set of regional scenarios was

Table 1. Projections of waterborne commodity flows for St. Louis bi-state region: 1976-2000.

Commodity	High-Growth State		Normal-Growth State		Low-Growth State	
	Increase (%)	Tons	Increase (%)	Tons	Increase (%)	Tons
Cash grains	100	6 275 904	68	4 267 397	55	3 420 086
Iron ore	50	13 608	42	11 431	38	10 342
Metal ores	54	71 618	44	58 356	40	53 050
Coal	372	27 215 541	319	23 338 056	218	15 948 892
Petroleum and petroleum products	66	13 257 291	54	10 846 875	41	8 235 590
Sugar	35	199 581	29	165 366	23	131 153
Grain mill products	45	2 392 246	39	2 073 280	34	1 807 475
Lumber products	90	4 763	80	4 234	68	3 599
Paper products	90	65 317	85	61 689	79	57 334
Chemicals	160	3 109 339	109	2 118 237	90	1 749 003
Iron and steel products	102	1 350 798	85	1 125 665	76	1 006 477
Nonferrous products	84	70 760	78	65 706	68	57 281
Fabricated metal	114	67 132	91	53 587	60	35 332
Mining products	108	5 346 947	90	4 455 788	66	3 267 579
Nondurable manufacturing goods	60	173 851	48	139 080	36	104 311
Durable manufacturing goods	100	5 493 003	72	3 954 962	54	2 966 222
Total		65 107 699		52 739 709		38 853 726

Notes: 1 t = 1.1 tons.
High is 23 percent higher than norm; norm is 36 percent higher than low.

constructed. Waterborne commodity flows are strongly tied to the demand for raw-material inputs to basic industry. Thus, an initial examination of regional economic parameters that are often tied to basic industry provides a logical starting point from which to refine macroscale commodity-flow forecast model output.

Conditions termed economic "growth states" are related to these regional parameters in the table below:

Parameter	Growth State	Increase (%) 1980-1990	Increase (%) 1990-2000
Population	Ideal	17.0	13.0
	High	14.0	10.0
	Normal	11.3	7.3
	Low	8.0	6.0
Total employment	Ideal	28.0	24.0
	High	21.9	17.9
	Normal	15.6	14.1
	Low	11.5	10.5
Manufacturing employment	Ideal	34.1	26.7
	High	25.1	15.2
	Normal	13.3	11.0
	Low	12.6	9.4
Personal income	Ideal	143.3	124.0
	High	119.9	110.0
	Normal	98.6	89.5
	Low	62.9	55.3

It can be seen that the ideal, or "economic boom", state shows relatively great increases in regional population, total employment, manufacturing employment, and personal income over a two-decade future period. The high-growth state shows significant, but more realistically attainable, levels of these parameters, whereas the normal-growth state represents a status quo without meaningful growth in economic indicators and the low-growth state depicts the region in decline relative to other national and midwest economic centers.

FORECASTS OF REGIONAL COMMODITY FLOWS

A set of refined St. Louis bi-state regional commodity flows based on the above regional economic scenarios was developed as follows:

1. Bureau of Economic Analysis Region (BEAR) regression forecasts of previous St. Louis port studies were reviewed for levels of original data aggregation, commodity classification, and statistical quality of variance.
2. Detailed reviews of industrial and port-related market studies and surveys were made to accurately assess target industries of the St. Louis region that have an impact on waterborne commodity movement on the river and respond in a predictable manner to national economic and trade developments.
3. Detailed interviews were conducted with barge operators, railroads, truckers, basic industries, and agricultural interests that make use of the river and unique intermodal linkages and unit-train/unit-tow combinations along the St. Louis riverfront.
4. The baseline commodity flows from step 1 were then adjusted to reflect regional wealth and marketing impacts. Adjustments were made to yield output for three of the four economic states (see Table 1).
5. At the request of community industrial interests, the high-growth state was studied in detail as a basis for the design of particular port facilities and the development of an industrial incentives strategy.

A review of Table 1 in light of these steps exhibits several results worthy of note:

1. No forecast was made for the ideal, or "economic boom", state. It was felt that to assume the number of simultaneous economic-inflation, energy, and international political and trade factors required to be in harmony to achieve such a state was unrealistic and would yield no real meaning.
2. Forecasts for the other three states exhibit the difference between high and declining regional economic activity and its relation to port development and waterborne commodity flows. The gross total of flows for the high-growth state, 65 107 699 t (71 768 956 tons), is 23 percent higher than the normal (status quo) state of 52 739 709 t (58 135 580 tons), which is 36 percent higher than the tonnage of the low-growth (regional decline) state [38 853 726 t (42 828 903 tons)].
3. Key commodities can be identified from the table that represent response to the unique intermodal-agricultural hinterland location of St. Louis, and/or its strategic position below Locks and Dam 26, or response to regional market study indicators. These are cash grains and grain products, coal, petroleum and petroleum products, chemicals, and fabricated metals.

HIGH-GROWTH-STATE DESIGN FOR KEY COMMODITIES

For the purposes of port district facility design and future interaction with potential growth industries likely to be attracted to the region, achievement of the high-growth-state economic target and port development was stated as the planning goal by the analysts over the 20-year development horizon. The following comments are relevant to the key commodities mentioned above as forecast for the high-growth state.

Grain

The public does not realize that a crisis in the movement of grain from the farmer to the export port has been building since 1973. The energy crisis has overshadowed the crisis in the transportation and storage of grain. National attention has been focused on the negative balance of payments, and little attention has been directed toward the dramatic growth of grain exports that occurred in the same time period as the escalation of oil prices.

Grain marketers generally agree that 1979 exports of midwest grains will be twice the 1973 quantities. Some indicate that the total may be as much as three times the 1973 level. It is this dynamic growth in the demand for transportation of grain from the farmer to the seaport that has caused the crisis. The national transportation capability, whether it be truck, rail, or water, has been overwhelmed by such growth.

In an effort to meet the demand, the transportation industry has overloaded the builders of covered hopper cars and the shipyards with orders for new equipment. The entire equipment-producing industry has been working at full capacity for several years, yet their effort has done little more than blunt the severity of the crisis. Today the lead time for delivery of a covered hopper barge suitable for carrying grain is at least a year and may be as much as 18 months.

Five years ago there was a market in equipment and power for the transportation of grain. Today every barge has long since been contracted for, and the new barges being built are snapped up six months before they are delivered. The demand for transportation far exceeds the equipment supply, as shown by the recent tradings in barge freight at rates between 300 and 400 percent of base.

Each mode has, in its own way, made a commendable effort to accommodate the extremely rapid increase in the demand for transportation equipment to carry grain from the farmer to the port. Since very little of the grain from the upper Midwest moves to the Gulf Coast by truck, the greater part of this burden has fallen on the railroads and the water carriers.

For some time, leaders in the grain and transportation industries have been speaking out publicly in an effort to attract attention to the crisis in the movement of grain. One of their strongest points is the preeminence of grain in countering the pattern of a negative balance of payments. These leaders are consistently urging that the grain marketers, the transportation industry, and governments join in a united effort to implement the movement of grain to the ports for export. Provincial differences, many regulations, and proprietary interests will have to yield in the interest of achieving the common objective if the crisis is to be overcome.

Coal

The most phenomenal increase in commodity tonnage is in western coal: One to three 100-car unit trains interchange with a daily 10-barge unit tow bound for power plants in Louisiana. This break-bulk occurs at the coal terminal of the Burlington Northern and American Commercial Barge Lines, Inc., in the north St. Louis riverfront area. Two more such terminals are in the planning and preconstruction stages in the bi-state region and will be capable of efficiently servicing Illinois soft coal if the demand and environmental restrictions allow it.

Petroleum

Increases in petroleum and petroleum products represent some interregional short-distance movements that complement the pipeline confluence in and north of the St Louis region. The potential of grain-related fuels is currently under investigation in the region, and "energy centers" of port industrial land use are envisioned at key riverside locations. Land options are currently being considered for gasohol plants surrounded by grain-product-related land uses. Thus, the increase in the tonnage of petroleum products is largely seen to service such energy-center concepts and yield a variety of petroleum haulages (such as raw gasoline, alcohols, and glycols).

Chemicals

Continued regional increase in chemical flows correlates with detailed regional market analyses that show St. Louis' continued growth as a center of chemical manufacturing, research, and education. The sunk cost of the facilities and highly trained personnel for the chemicals industry available in St. Louis, as well as the presence of good surface transportation for shipment of small packaged finished products, causes its growth inertia to increase.

Fabricated Metals

The growth in fabricated metals represents a regional economic demand for more labor-intensive basic industry identified in marketing studies. It is felt that the St. Louis region could absorb two or three new major fabricated-metal plants--at least one near the Central Harbor area. The presence of available raw and redevelopable land north of the Central Harbor and the pressure to reduce unemployment are behind the drive to establish this industry in the port zone. The result is the forecast of increased tonnage.

IMPACTS OF INCREASED COMMODITY FLOWS ON RIVER OPERATIONS

The above increases in regional commodity flows into and out of the Port of Metropolitan St. Louis, considered in addition to through traffic, will have several impacts on port operations that deserve careful monitoring:

1. Studies being performed for a district of the port region indicate that achieving the high-growth state discussed above will cause some 85 600 barges to be handled in a towing season in the St. Louis area. This, in conjunction with through traffic, produces the potential for congestion.
2. Fleeting in St. Louis is currently at a premium. In view of forecast growth, a fleeting management effort must be developed. A U.S. Maritime Administration university research effort is in the initial phases of addressing this problem.
3. Given the forecast potential for growth in commodity flows of coal and grain and increased use

of the St. Louis public terminals, it will be imperative to achieve maximum efficiencies in unit-train/unit-tow and joint rail-water through rates. If modes are slow to opt for cooperation, they will impede a geographic and "facilities-in-place" locational advantage for the region for the key cargoes discussed above.

CONCLUSIONS

This paper has attempted to heuristically examine some practical aspects of forecasts of key commodity flows for a regional port. Data and forecasts are taken from an ongoing port district study in the Port of Metropolitan St. Louis. The study is oriented to matching commodity flows with detailed market study and regional economic forecasts. In the current national processes of inflation, economic scarcity, altered energy use and growth incentives, and the onset of new national financial policies for water transportation, it is pertinent for individual ports to reexamine their role in the total transportation context and refine their growth strategy around unique geographic, engineering, operational, and industrial features.

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Federal Interest in Effective Transportation Use of Major River Navigation Systems

WAYNE E. CALDWELL

The essential elements of major river navigation systems and the federal interests that have an impact on their effective use are discussed. Optimal use of these systems is stressed as a national goal in these energy-conscious times. The public and federal regime in which the waterways industry must operate and specific federal programs of interest are discussed. These include channel design and maintenance, water resources management, navigational aids, alteration of obstructive bridges, regulation of movable bridges, and bridge construction permits. The commercial vessel safety program of the U.S. Coast Guard and waterways improvement efforts of the U.S. Army Corps of Engineers are outlined. Coast Guard experience in preventing and responding to incidents of oil pollution and the growing concern about hazardous-materials accidents are examined.

In the summer of 1979, I returned to Washington after serving three years as Commander of the Second Coast Guard District. This inland empire, with headquarters in St. Louis, comprises all or part of 22 states and includes all of that major inland waterway system commonly referred to as the "western rivers". The Second Coast Guard District serves all who are associated with the great rivers; however, the towboat and barge industry is its most important, and sometimes noisiest, customer.

While serving as commander of the district, I became one of the local river rats and, like my predecessors, learned a good deal about the rivers, the people who make their living on them, and the unique language of the profession, and I became more convinced than ever of the important role the rivers play in our national economy. I departed with a clearer vision of the mutually supportive roles that the industry and the U.S. Coast Guard play in this vital area and with a deep respect for the professional in this interesting industry.

Although the basic aim of the Coast Guard is to facilitate commerce on the rivers, from time to time it seems to be accused of hindering it. Perhaps this occasional opposition can be placed in a better perspective if its aim is redefined by adding a word. The aim of the Coast Guard is to facilitate "safe" commerce. Sometimes its views of what is required for safe commerce vary a bit from the views of the industry, in terms of actual need, expected results, and above all the cost to the industry in both time and money. In spite of these minor variances, the Coast Guard shares with the industry a deep concern for safety.

Perhaps, before discussing what I mean by the effective use of a major river navigation system, I should first define my terms. The dictionary says that effective means "adequate to accomplish a purpose"; however, I doubt whether any of us would be satisfied with simple adequacy. Adequacy seems, more often than not, to imply marginal performance.

I support the premise that we must demand more than simple adequacy from our river systems. To my mind, effective use implies efficient use or perhaps could even be stretched a bit to mean optimal use. This should be the goal in the management of the river systems.

Optimal use of the river transportation system is of vital importance to the nation in the present energy crisis and will be in the coming decades of energy conservation. The river system has always provided a means for energy-efficient transportation, but never before has it had such an overriding advantage. The river system is a national asset that must be exploited and optimized. We must, as a national goal, do everything possible to strengthen this system and ensure that simple adequacy is replaced by optimal use.

How is the optimum to be achieved? What are the necessary elements in providing this kind of river navigation system, and who should be involved in this optimization effort? These are the subjects discussed in this paper.

THE RIVER NAVIGATION SYSTEM

The river navigation system is made up of many items, all tied closely together: (a) towboats and barges, (b) their crews, (c) the confines of the waterway and the water in it, (d) navigation aids, (e) obstructive or hindering elements such as bridges and locks, (f) terminals, (g) the cargoes transported or available to be transported, and (h) the interface with other transportation modes. This complex system must operate in an environment of legal constraints, public concerns, and competition that affect its every move. These consist of ever-expanding laws and regulations and

environmental concerns, the inability of the federal government to finance all needed improvements, and the need to compete for business in the real world of hard dollars and cents. In spite of these constraints, the waterways industry manages to thrive.

Of prime importance in this system is the constantly changing waterway itself. Except in the case of passage through a lock, the maximum capacity of any waterway is not really known. Waterway capacity would appear to be limited only by the number of available towboats and the volume of commodities to be carried. It is obvious that this cannot be the case, but it is equally obvious that, with the exception of a few bottlenecks, there is massive unused transportation capacity available.

However, if the waterways are to operate safely, carrying high tonnage, they must have well-aligned and well-maintained channels with suitable dimensions. The U.S. Army Corps of Engineers is a vital partner in this area. We all need to know more about what constitutes an optimum channel. Important work is being done in real-time computer simulation of towboat maneuvers in restricted channels, and it is hoped that this may help in decision making on this important parameter. Although the Corps of Engineers has federally delegated responsibility for channel development and maintenance, the experience of pilots who daily travel the waterways is an essential need in support planning for improvements. The federal government must, with industry experience, seek out and eliminate the all-too-frequent bottlenecks in the inland navigation system.

Efficient water conservation, flood-management practices, and pool-level maintenance are also federally coordinated responsibilities that affect the water transportation industry.

The water resources of the United States are used for many purposes. In water-deficient areas, these multiple uses must compete with each other for the available water in the region. Congress responded to the need for comprehensive planning for the use of water resources by enacting the Water Resources Planning Act of 1965. This act established the Water Resources Council, a cabinet-level forum made up of top-management-level representatives from departments that are involved in the control and management of water at the federal level. Title 2 of the act established authority for regional coordination through the organization of river basin commissions composed of state and federal members from the affected area. In addition, Title 2 authorized financial assistance to individual states for water-related planning by means of matching grants.

The Commandant of the U.S. Coast Guard has been designated as the U.S. Department of Transportation (DOT) coordinator for water-resource activities and serves as the alternate for the Secretary of Transportation on the Water Resources Council. Appropriate officials in the various DOT operating agencies are designated to represent DOT views on the various regional river basin commissions.

One of the important Coast Guard roles is to provide a system of navigation aids in which individual aids are suitably placed, are dependable in operation, and are promptly serviced when outages occur. For the most part I feel that it meets this need, but the present system, with a few exceptions, is the historical result of meeting individual needs as they occur. I admit that the Coast Guard has not done as well as it should in providing uniform operational criteria for the best selection of the type and specific placement of navigational aids. The result of incremental growth is that some waterways are marked better than others. However, steps are being taken toward system uniformity and toward organizational provision for a waterway audit function to assess the problem.

The proper marking of waterways is a costly as well as an extensive operation. In the Second District, for example, the Coast Guard maintains aids to navigation over more than 6500 commercially navigable river miles, 4600 of which support navigation on a year-round basis. The 18 Coast Guard vessels stationed throughout the Second District maintain almost 4000 fixed aids and more than 9000 buoys. All of these are serviced regularly by about 450 Coast Guard personnel. The navigation-aids effort accounts for almost half of the total workload in the Second District, which had an operating budget of almost $25 million in fiscal 1979.

BRIDGES

Another type of waterway bottleneck, in addition to channel dimensions, exists in the form of bridges whose horizontal and/or vertical clearances provide unreasonable obstructions to navigation. Most of the existing railroad bridges in the Second District were built around the turn of the century. Some people have described such bridges as monuments to poor planning, but I would submit that the growth of inland waterway development since World War II has been far beyond what could have been foreseen by even the most perceptive planners at the turn of the century. Under Title 33 of U.S. Code 511 (the Truman-Hobbs Act), the Coast Guard maintains an active program for ordering the alteration of unreasonably obstructive bridges. Although the program results are sometimes criticized for being inadequate compared with evaluated needs, the Coast Guard takes pride in what has been accomplished. The average annual budget level for this activity has reached $8 250 000, but the competition for funds to alter obstructive bridges is high, costs continue to spiral, and real dollar resources are limited.

In the development and issuance of orders to alter bridges, there is now a backlog of nine projects that are partly funded and under way, four outstanding orders for which funding will be requested in FY 1981, and studies in progress that may soon lead to an additional four orders to alter. As navigation needs increase, the Coast Guard intends to be responsive in seeking elimination of this type of bottleneck.

In an ideal waterway, all bridges would be fixed, high-level structures that provide no interference with or obstruction to navigation. In the real world, however, we must live with the 1855 U.S. bridges that lift, swing, or otherwise move to allow the passage of navigation. Another Coast Guard program is the regulation of these bridges so that the terms, conditions, and hours of their operation satisfy the concerned waterway user without unduly penalizing the motor vehicles or trains that are also affected by their operation.

In a related program, the Coast Guard processes and issues permits for the construction of almost 300 new bridges each year. The aim of the program is to ensure that permits are issued only for bridges that have clearances that are sufficient to meet the reasonable needs of navigation. On most of the waterways systems, minimal guide clearances are established, and all bridges on the waterway are constructed to meet these requirements.

SAFETY

The Office of Merchant Marine Safety is another member of the Coast Guard team whose activities have an impact on the river systems. The commercial vessel safety (CVS) program is especially worth mentioning here.

The objective of the CVS program is to minimize deaths, personal injuries, and property loss or damage associated with vessels and other facilities engaged in commercial activity in the marine environment. This objective is pursued through the administration of federal laws and the development and enforcement of federal standards. Efforts in promoting the safety of life and property can be divided into three basic areas: vessel inspection, the licensing and documentation of seamen, and the investigation of marine casualties. The CVS program uses a network of 50 field offices, supported by district and headquarters staffs, in performing the following functions:

1. Plan review of all U.S. commercial vessels engaged in certain trades,
2. Inspections of all such vessels while they are under construction,
3. Periodic inspections of all such vessels after they are placed in service,
4. Licensing and/or documentation of seamen to serve on such vessels, and
5. Investigations into marine casualties and personnel misconduct, negligence, or incompetence.

Another area of federal involvement--and a responsibility of the Corps of Engineers--is the construction, operation, and maintenance of the numerous locks along U.S. waterways. These, like bridges, have been built in one era and sometimes do not meet the increasing needs of the commerce of a later time. Typical of these is Locks and Dam 26 at Alton, Illinois, which is now proceeding toward a completion date of 1989 at an estimated cost of $491 million. Another example is the Tennessee-Tombigbee Project, which will be completed by the Corps of Engineers in 1986 at a cost of more than $1.6 billion. Other projects could be mentioned, such as those on the Red River, but the point is that the Corps of Engineers plays an all-important part in the improvement and extension of the nation's waterways system. There is little doubt that the vitality of the river systems and of the towing industry today is largely due to the efforts of the Corps of Engineers.

Yet another area of federal involvement is navigation safety. In a 1979 report prepared for the Coast Guard (1), casualty statistics covering a four-year period were enumerated for the western rivers and the Gulf intracoastal waterways. They included 245 bridge rammings and 61 groundings. Each of these incidents was routinely investigated by a Coast Guard marine inspection office, and in each case an attempt was made to determine the cause. The results of work of this type provide input for Coast Guard program managers and give them a basis for remedial action. This is one of the means by which the Coast Guard assesses the adequacy of its navigation aids, inspection programs, bridge program, and regulatory activities. It is interested in where a particular system fails and what can be done to correct it in order to prevent similar failures.

Collisions, rammings, and groundings can be of considerable concern to parties other than the people immediately involved. Sailors say, "A collision in the morning can spoil your whole day". But times have changed, and now we find that a collision involving a tank barge that results in a major pollution incident can spoil a whole day for a whole lot of people, some as far away as Washington, D.C.

With the advent of the Federal Water Pollution Control Act of 1972 and a host of other environmental legislation, the Coast Guard and the U.S. Environmental Protection Agency have come down hard on the problems of oil spills in U.S. waterways. In dealing with the situation, a number of approaches are used:

1. Maximum emphasis is placed on prevention of spills through a regulatory regime that covers barges and terminal facilities and how both are operated. The Coast Guard is interested only in reasonable standards that it feels will produce concrete and visible results.
2. The Coast Guard has set up the necessary organization, communications equipment, personnel, and open contracts with private firms to promptly respond to spills and potential spills, not only to clean them up but also to minimize environmental harm.
3. Legal penalties are imposed on spillers to provide an incentive for compliance with the regulations and perhaps to urge a bit more environmental concern on the part of industry. Traditionally identified for its search-and-rescue efforts in protecting people and property from the sometimes hostile actions of the marine environment, the Coast Guard is now busily engaged in protecting the marine environment from the sometimes hostile actions of mankind.

Unfortunately, the message is not always hitting home. Each year since 1974 has seen an increase in the number of known spills in inland waters, from 2000 in 1974 to almost 5000 in 1978 (2). We have been in the habit of rationalizing this on the basis that the reporting is getting more accurate each year. I personally think that such reasoning is wearing thin. If the figures are accurate, we are faced with a serious problem that must inevitably lead to tighter federal control and greater federal involvement.

We must reduce pollution by oil. The only preventive means at hand are controls on the equipment, the people, and the operating methods. It is quite probable that the existing body of regulations is adequate and that the situation can be considerably improved by a greater effort on the part of waterway operators and facility managers as well as more rigid enforcement and inspection activity by the Coast Guard.

This problem of prevention and response in relation to oil pollution is far from a satisfactory conclusion, and yet another element is being added. Oil spills harm the environment but only indirectly affect people. The new problem, that of accidents involving hazardous materials, strikes directly at the people in the industry and the public at large. An incident involving a chlorine barge can spoil the days for everyone in the affected area for a long time. Here again, there has been a steady increase in incidents since record keeping started.

We have just begun to scratch the surface of this problem. However, everyone should be aware that federal involvement, particularly in the absence of adequate industry concern, will expand and become more pervasive until a reduction in these incidents takes place.

The Cargo and Hazardous Materials Division in the Office of Merchant Marine Safety approaches these problems from the standpoint of vessel construction standards, by using the following means:

1. Drafts rules and regulations for the transportation, handling, loading, discharging, stowage, storage, and use of explosives or other dangerous cargoes;
2. Determines the kind and degree of hazard inherent in the water shipment of dangerous substances;
3. Reviews regulations, international standards, and proposals that relate to (a) protection of the environment in water transportation of hazardous materials and (b) vessels and waterfront facilities from the standpoint of environmental pollution hazards;
4. Makes studies of the behavior and effects of pollutants released to the environment under normal and accident conditions; and
5. Predicts trends in the transportation of hazardous materials and their evaluation in terms of future environmental hazards.

SUMMARY

Federal interest in effective transportation use of major river navigation systems has manifested itself in actions to facilitate safe commerce. Today's need for the conservation of energy will unquestionably attract greater federal interest because of the recognized energy efficiency of waterway transportation. Reasonable people also recognize that a balanced capability among all modes of transportation (water, air, rail, and truck) is essential to meet the nation's needs. Industry as well as the federal government will be challenged to identify national transportation needs and to promote a homogeneous interface among the modes. It is conceivable that such efforts will work changes in the predominant bulk shipment of coal, grain, fertilizers, petroleum products, and chemicals on U.S. inland waterways. It is reasonable to assume that container and roll-on/roll-off cargo-handling facilities will begin to emerge on the riverbanks much as they were introduced to ocean ports as the result of transportation technology.

Whatever the future holds, energy efficiency as well as the need for safe commerce will be an important factor in shaping federal interest in effective transportation use of major river navigation systems.

REFERENCES

1. B. A. Paramore and others. Human and Physical Factors Affecting Collisions, Rammings, and Groundings on Western Rivers and Gulf Intracoastal Waterways. ORI, Inc., Silver Spring, MD, Jan. 1979. NTIS: AD A074 920.
2. Polluting Incidents In and Around U.S. Waters. U.S. Coast Guard, Commandant Instructions M16450.2, CG-487, Jan. 14, 1980.

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Analysis of Towboat and Barge Use on Inland Waterways

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In 1975, the U.S. Army Corps of Engineers instituted the Performance Monitoring System (PMS) at locks on inland waterways. PMS data, collected at each lock, allow the Corps to monitor the use of navigation locks and traffic movements and to analyze tow operating characteristics. Based on data derived from PMS, the Corps developed a computer program called VESUSE to analyze inland-waterways use of towboats, barges, and flotillas by simulating their movements. The elements of the VESUSE program are described and are found to be reliable. The information on the characteristics of vessel utilization is useful for studies related to inland-waterways operations and planning.

The VESUSE computer program, developed by the Navigation Analysis Center of the U.S. Army Corps of Engineers, makes it possible for the first time to assess and analyze the characteristics of tow-equipment use on inland waterways. These characteristics are significant for various studies of operations and planning for inland waterways. Input to VESUSE are Performance Monitoring System (PMS) data on the movements of tows and barges through navigation locks. The program infers the movements that have taken place between the locks and from them estimates how many operational vessels of various types are present on a given section of inland waterway during a given time period. An operational vessel is defined as one that moves through a lock during the time period. The program also estimates the fraction of the time an average vessel of each type is in use or idle.

This paper presents a description of the various elements of the program.

PERFORMANCE MONITORING SYSTEM

PMS is a system of data collection at navigation locks whose purpose it is to monitor lock operations and the passage of commercial vessels through the locks (1). From a PMS data record, VESUSE extracts the lock code, direction of the lockage (upstream or downstream), identification number of the towboat, times and dates when the flotilla arrived in the lockage queue and completed the lockage, whether or not the flotilla had stopped since its last lockage, and the horsepower of the towboat. It also obtains the number of light boats in the lockage (commercial towboats that are not carrying cargo or pushing barges and that passed through the lock at the same time as the main flotilla). Finally, VESUSE obtains a table describing barges from the record. For each group of barges, the table gives the type of the barges, what commodity and how many tons they were carrying, and how many barges constituted the group. The data that PMS supplies on vessel movements between locks are very sketchy. Moreover, PMS data are not entirely reliable. These facts may limit the accuracy of the program's results.

CLASSES OF VESSELS

The classifications of the vessels used are the 9 barge categories used in PMS, 11 categories of towboats (distinguished by horsepower range), and the

Figure 1. Extract from transit-time report.

From Lock	To Lock	Transit Time (days)	Distance (miles)	Direction (upstream, downstream)
IL08	MI26		95.0	D
IL08	MI25		104.0	D
MI24	MI25		32.0	D
MI25	MI24	Variable	32.0	U
MI25	IL08		104.0	U
MI25	MI26		41.0	D
MI26	IL08		95.0	U
MI26	MI25		41.0	U
.	.		.	.
.	.		.	.
.	.		.	.

category of "light boats", which are any towboats whose horsepower was not reported in the data. The table below gives the barge categories used:

Barge Category	Symbol
Seabee or LASH	B
Bulk cargo vessel (self-propelling)	C
Integrated (made up as a unit to operate integrally)	I
Regular or long jumbo barge	J
Motorized	M
Small regular barge	R
Super jumbo barge	S
Bulk tanker vessel (self-propelling)	T
Other	Z

The following towboat categories are used (in horsepower): 0-600, 601-1200, 1201-1600, 1601-2000, 2001-3400, 3401-4400, 4401-6000, 6001-7000, 7001-8000, 8001-9000, ≥9001, and light boats.

TRACKING OF VESSEL ACTIVITIES

The VESUSE program tracks the travel of a particular tow complex, or flotilla, by grouping together the lockage records pertaining to the prime vessel (towboat) and sorting these records according to the time and date of the lockage. However, rather than tracking a flotilla's travel throughout the system during the given study period, it tracks its travel through one pool at a time, from entry to exit. Stated another way, the program looks at one pool at a time and studies all the flotillas that passed through (or just into or out of) that pool during the study period.

TRANSIT TIME

When the program has records of a flotilla's entering and subsequently leaving a pool, and when there was no stop in between, the program subtracts the time of the flotilla's entering the pool from the time of its leaving to obtain its transit time. The program computes averages of the transit times from each lock to each adjacent lock in the study area and records these averages in the transit-time report (see Figure 1).

In a future version of VESUSE, sophisticated statistical methods may provide more accurate predictions of transit time by using such predictors as season of the year, upstream versus downstream travel, distance between locks, towboat horsepower rating, tonnage of freight pushed, and number of barges pushed.

SIZE OF OPERATIONAL BARGE FLEET

Next, the program looks at one pool at a time and again studies the travel of flotillas through the pool, accounting for each barge. To be precise, if a flotilla takes barges out of the pool that it did not bring in and that were not brought in by a previous flotilla during the study period, then the program deduces that those barges were already present in the pool at the beginning of the study period. Since every barge must have been present in some pool at the beginning of the study period, this leads to an estimate of the size of the operational fleet. The program assumes that an operational barge is one that moves through a lock during the period of study. The same logic applies to light boats.

ACTIVITY OF BARGES

While applying this accounting type of approach to computing the number of barges in the system, the program also develops a composite figure for the amount of use each type of barge received during the study period. This figure is in the form of barge-use days.

The assumptions underlying the barge-use-day statistic are the following:

1. If a barge traveled through a pool as part of a flotilla that did not stop in the pool, then it was "in use" for the entire time the flotilla was in the pool.
2. If the flotilla did stop for partial refleeting and then went on, still pushing one of the same barges it came in with, then the barge was "in use" for the amount of time that the flotilla would have required for nonstop travel between its point of entering the pool and its point of leaving. This time requirement is estimated from the transit-time report (Figure 1). The barge was "idle" the rest of the time it spent in the pool (during which time refleeting was presumably taking place).
3. If a barge entered the pool with a flotilla and remained there, then it traveled with the flotilla half of the distance between the flotilla's point of entering the pool and its point of leaving and was deposited midway at a hypothetical dock. It was in use for as much time as the flotilla would have required to travel from its point of entering the pool to this hypothetical dock and thereupon became idle (again, the time requirement is estimated from the transit-time report). In the VESUSE program, this idleness is different from the idleness discussed in the second assumption above, since the program cannot individually identify or track the barge any further. At this point, the accounting type of study discussed earlier enters in.
4. If a barge joins a flotilla in the pool and leaves with it, the case is the converse of assumption 3 above and is treated accordingly.
5. Time spent in loading or unloading is idle time.
6. Time spent waiting in lockage queues is in-use time.

The results of this portion of the study are recorded in the barge-use report (see Figure 2).

BOUNDARY CONDITIONS

A flotilla may enter a pool and remain there until the study period is over or enter a pool before the study period begins and then leave. In such a case, the VESUSE program makes an educated guess about where the flotilla was going to or coming from. For pools bounded by two locks, this guess is simple to make. Lacking concrete information, the program assumes that a flotilla that entered the pool but did

Figure 2. Extract from barge-use report.

Barge Type / Pool	B	C	I	J	M	R	S	T	Z	Total
MI25	#	#	#							#
	%	%	%							%
MI26	#	#	#							#
	%	%	%							%
.										
.										
.										
	#	#	#							#
	%	%	%							%

Note: # = average number of operational barges;
% = percentage use of operational barges.

Figure 3. Extract from tow-use report.

Horsepower Range / Pool	1-600	601-1200	1201-1600	. . .	9000-*****	Total
MI25	#	#	#			#
	%	%	%	. . .		%
MI26	#	#				#
	%	%		. . .		%
.				. . .		
.				. . .		
.				. . .		
Total	#	#				#
	%	%		. . .		%

Note: # = average number of operational towboats;
% = percentage use of active towboats.

not leave during the study period traveled to the midpoint of the pool and then became idle. Conversely, it assumes that a flotilla that left the pool was formerly sitting idle at the midpoint of the pool and traveled the distance from the midpoint to the lock by which it exited. (In a pool at a confluence, the hypothetical midpoint is established by averaging.) The time requirements for traveling between the midpoint of a pool and each adjoining lock are included in the transit-time report.

TOWBOAT USE AND FLEET SIZE

Since every towboat is individually identified in the PMS records, establishing the size of the active fleet of towboats should be straightforward, with one exception: A lone towboat may be locked through as a light boat together with other light boats or with a flotilla, and in that case its identification number will not be in the PMS records. The VESUSE program treats light boats much like a tenth barge category. Observe, however, that a towboat may enter a pool as part of a flotilla and leave as a light boat, or vice versa, and that the program takes this into account.

The statistics on tow-use days are compiled in much the same way as those on barge-use days, but of course a flotilla may drop off or pick up a barge, but not a towboat, on its way through a pool. Furthermore, a towboat may enter a pool, refleet, and then turn around and go back out the same way; we assume that a barge does not do this without stopping to be loaded or unloaded. When a tow does this, we assume that it travels to the pool's hypothetical midpoint, drops off all its barges and picks up new ones, spends zero or more time idle, and travels back to the lock, where it exits.

Tow-use statistics are recorded in the tow-use report (see Figure 3).

SUMMARY

The VESUSE program provides us with very useful information on the use of towboats, barges, and flotillas. It serves our need for some insight into how towing equipment is used. A more sophisticated program is planned for the future as demand arises.

The Navigation Analysis Center will supply the program and the user's manual on request.

REFERENCE

1. Performance Monitoring System: Engineering Circular, rev. ed. Office of the Chief of Engineers, U.S. Army Corps of Engineers, 1979.

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State Water-Port Master Planning

MARTIN L. MILLER AND JOSEPH M. GILROY

Existing state roles in transportation and water-port planning and their relationship to other planning activities are explored. A rationale for expanding states' water-port planning responsibility is discussed, and alternative approaches to developing a state water-port master plan and a description of the components of such a plan are presented. It is concluded that cooperation between state governments and local port agencies provides an effective political and operating mechanism for bridging the gap between national and local objectives.

A recently completed report by the General Accounting Office (1) raised serious questions about the ability of local port agencies to continue financing much-needed capital improvements. Without recommending a specific course of action, the report questioned the efficacy of the "go-it-alone" competitive environment in which ports currently operate. It recognized the national importance of ports and

said that if Congress decides to act in this area it should consider, in addition to maintaining the status quo, various options of a national port plan and federal funding.

Port development is a complex process. Federal, state, regional, and local agencies interact with one another and with the private sector. Federal interests alone may be represented by as many as a dozen agencies. Federal agencies that have varying degrees of water-port involvement include the U.S. Army Corps of Engineers, the Maritime Administration and the Economic Development Administration of the U.S. Department of Commerce, the Office of Coastal Zone Management, the Office of the Secretary of Transportation, the U.S. Coast Guard, river basin commissions (on the inland waterways), the U.S. Environmental Protection Agency, the Federal Maritime Commission, the Interstate Commerce Commission, and the Tennessee Valley Authority.

Within the states, responsibility for water-port development may be lodged with state agencies, autonomous port authorities, or local municipalities. Ports are located in 41 states--on the Atlantic, Pacific, and Gulf Coast; on the Great Lakes; and on the inland waterways. In a survey of 33 of these states (2, p. 59), it was found that 12 had state port authorities, 12 had a ports agency within a state department of transportation (DOT), and 9 had no particular state port agency. The recently completed Mid-America Ports Study, which addresses the inland port needs of 17 states, draws the following conclusion (3, p. 19):

> State governments make significant contributions to port development. . .by providing firm legislative authority for exercise of local incentives. Twelve Mid-America states have general enabling statutes that authorize local governments to create port authorities. In three states riverport development is a responsibility of agencies (state) closely integrated with the structure of general government.

The creation of state departments of transportation (DOTs) has reinforced the role that states can perform in water-port development. As of 1979, 38 states had DOTs. The creation of state DOTs resulted in part from a desire to coordinate transportation development in a multimodal framework. Most states have the statutory authority to undertake multimodal planning. For example, the New York State DOT is given the responsibility to develop a balanced transportation policy. As the New York State Transportation Law, which established the state DOT in 1967, states, "The DOT shall. . .formulate a statewide Master Plan. . .including highways, rapid transit, railroad, omnibus, marine and aviation facilities. . . ."

Largely in response to federal requirements, statewide planning has been geared to highway, mass transit, and aviation planning. The intermodal characteristics of water ports have been largely ignored by the majority of the states, although the results have been excellent in those instances in which states have taken a role. This apparent lack of substantive involvement in port development is inconsistent with the multimodal nature of waterborne transshipments: Waterborne commerce moves to and from the port area by truck, trailer, pipeline, rail car, or container, and the port's efficiency and competitive standing depend on the service provided by one or more of these surface modes. The state's relative lack of involvement is understandable. There are no federal grants and, because a port moves freight and not people, it has low public visibility in the political sense. Moreover, states have provided local authorities with the enabling legislation necessary to pursue water-port development, a course of action local governments have supported.

As data given in Table 1 indicate, 13 states have completed or have under way either a statewide plan or a regional state plan; in the latter category is New York State, which conducted a study of upstate New York ports (4), and California, which, under the sponsorship of the Northern California Ports and Terminals Bureau, undertook a study of San Francisco Bay ports. According to data of the Office of Ports and Intermodal Development of the Maritime Administration, more than 30 states have been, are currently, or are planning to be participating in regional port plans partially funded by the Maritime Administration.

FEDERAL ROLE

The only federal agency that provides direct grants for construction of port facilities is the Economic Development Administration (EDA), and even EDA participation is limited to project areas that qualify

Table 1. State water-port functions in 1979

State	State DOT	Waterway or Port Function[a]	Status of State or Regional Water-Port Plans
Alabama	No	–[b]	A
Alaska	Yes	X	B
Arkansas	Yes	P	A
California	Yes	–	B
Connecticut	Yes	X[c]	Yes, statewide
Delaware	Yes	–	No
Florida	Yes	P	Yes
Georgia	Yes	X	No
Hawaii	Yes	X	Under way
Illinois	Yes	P, T[d]	A, C
Indiana	No	–	No
Iowa	Yes	P, T	A, yes
Kansas	Yes	P	A
Kentucky	Yes	P	A
Louisiana	Yes	–	A
Maine	Yes	X, P	No
Maryland	Yes	X, P	Under way
Massachusetts	No	–	No
Michigan	Yes	X, P, T	C
Minnesota	Yes	X	A, C
Mississippi	No	–	A
Missouri	Yes	X	A, yes
Nebraska	No	–	A
New Hampshire	No	–[e]	–
New Jersey	Yes	–	No
New York	Yes	X, T	B, C
North Carolina	Yes	–[e]	Planned
Ohio	Yes	T	A
Oklahoma	Yes	P	A
Oregon	Yes	P	Under way by another agency
Pennsylvania	Yes	X	A, C
Rhode Island	Yes	–	No
South Carolina	No	–[e]	Planned
Tennessee	Yes	X	A
Texas	Yes	P	Under way
Vermont	Yes	X	No
Virginia	Yes	–[e]	Under way
Washington	Yes	–[f]	Yes, update under way
West Virginia	No	–	A
Wisconsin	Yes	P	A, C

Note: A = state included in Mid-America Ports Study; B = regional port study or studies performed within the state; C = state included in Great Lakes Ports Study; P = planning; T = technical assistance; X = financial control or responsibility.

[a] Based in part on findings of the National Transportation Policy Study Commission (2).
[b] State Docks Department.
[c] Connecticut Department of Commerce.
[d] Department of Business and Economic Development.
[e] State port(s) authority.
[f] Washington Public Ports Association engages in statewide planning but is not a government agency.

as economically depressed. The Maritime Administration provides funds for statewide and regional port planning on a basis of cost sharing with the participants. Section 8 of the Merchant Marine Act of 1920 directs the Maritime Administration to promote, encourage, and develop ports and transportation facilities for water commerce. The act requires the agency to study water terminals, including docks, warehouses, and related equipment; to provide advice to communities; and to investigate the practicality of harbor, river, and port improvements. Currently, a total of 13 such state or regional studies have been performed or are under way. The Maritime Administration has been successful in bringing together a relatively diverse group of agencies to perform the studies. The study participants, however, are not obligated to carry out the study findings and have no financial incentive to implement the recommendations since the agency does not provide the development funds available from federal highway, aviation, and rail programs.

Of the dozen or so federal agencies involved in some aspect of port development, the more significant contributions are made by the U.S. Army Corps of Engineers, the Office of Coastal Zone Management, and the U.S. Coast Guard. The harbor, channel, and waterways navigation programs of the Corps of Engineers, including dredging and flood control, have an impact on port development. Of major importance are projects in channel maintenance, channel widening and deepening, and new-channel construction. The depth of a harbor or channel limits the size of the vessels that can use it for navigation and this, in turn, can affect the economic viability of port operations. Although the Corps of Engineers does not get involved in port development, it is obvious that its actions, or lack thereof, significantly influence the competitive balance among ports.

Coastal zone management (CZM) plans have a port and industrial component. The CZM program is administered at the federal level by the U.S. Department of Commerce, and planning grants are given directly to eligible states to carry out the study work. Ports are generally viewed as a secondary issue within the larger framework of developing a balanced plan that encompasses environmental, recreational, conservation, and industrial uses of the coastal zone.

Regulatory functions in the area of waterway safety, including the movement and handling of dangerous cargoes, are performed by the U.S. Coast Guard. The Coast Guard is also involved in the maintenance of aids to navigation and in the licensing of offshore deepwater ports.

An Office of Marine Affairs was created last year in the Office of the Secretary of Transportation. It is still too early to judge whether this office will play a role in port development.

STATE AND LOCAL ROLE

Water-port development is largely a local responsibility, whereas channel and harbor improvements are a federal responsibility of the Corps of Engineers. This creates a dichotomy in national policy, aggravated, at least in a conceptual sense, by the absence of a national port plan.

Proponents of the present system of port development argue that the combination of local initiative and private-sector investment is highly flexible and more cost effective than a centralized port program. The method of operation, both on the inland waterways and at coastal ports, is for local port authorities--many of which are operating under state enabling legislation--to finance and/or control the course of port development.

At the coastal ports, the public sector is largely involved in the development of general cargo facilities, such as container-handling terminals; bulk cargo-handling facilities, such as coal and oil terminals, have been built primarily by the private sector. On the inland waterways and the Great Lakes, bulk cargoes, such as grains, coal, and nonmetallic minerals, predominate. The end industrial users of bulk commodities on the lakes and waterways are usually located adjacent to the channel and construct the wharves and other cargo-handling facilities. Many private waterfront facilities for handling bulk commodities are located in haphazard fashion along the nation's navigable inland waterways. American Waterways Operators, Inc., reports that since 1952 more than 10 000 water-oriented industrial plants have been built on these waterways.

Without national or significant regional support or direction, the nation's ports have been able to adapt to changing technologies while continuing to accommodate growing volumes of cargo. The system has been largely self-financed with minimal use made of public funds. The absence of significant federal involvement permits local port authorities to act with greater flexibility than would otherwise be the case.

Nevertheless, local port agencies increasingly find themselves in situations that are beyond their control. Multinational maritime shipping companies can play one port off against another to the detriment of both shipper and consignee. The number of railroads serving the ports continues to decline, and the result is noncompetitive overland hauling rates. Minibridge and landbridge operations have pitted East Coast against West Coast and Gulf Coast ports, and the railroads and marine carriers set the rates that make this service so successful.

Port activities generate economic benefits that extend well beyond the area of influence of the local port authority. This is partly explained by the fact that waterborne commodity flows through a port do not necessarily originate within the immediate geographic area of the port, let alone within the same state. More than 66 percent of the total annual inland waterway tonnage moving through the 17 states included in the Mid-America Ports Study originates in another state.

The state level of government provides a convenient mechanism for bridging the gap between regional and local interests. Most states are already organized, or have the statutory authority, to perform multimodal planning; presumably this includes water ports. State-level port planning makes it easier to consider a larger public interest than could normally be considered at the local level. Moreover, state planning and financial resources can be more effective than comparable local resources in addressing regional issues.

The following reasons can be cited in support of pursuing state-level water-port planning:

1. State DOTs are engaged in multimodal planning, and state water-port planning efforts--in consultation with local interests--would be a logical extension of this role.
2. State energy plans are being promulgated. Waterborne transportation of energy materials is a principal concern. As utilities convert to coal-fired plants, the use of waterways to transport coal takes on greater importance. In addition, water transportation is one of the more cost-effective forms of freight transport.
3. The economic benefits generated by port activities are significant and have regional and statewide impacts. State and regional agencies involved in economic development and promotion can

maximize these benefits by working with state and local agencies to ensure closer integration of port and overland transportation programs and economic development activities.

4. CZM planning is being coordinated at the state level. An evaluation of the trade-offs between environmental, conservation, recreational, and industrial development issues in CZM requires a thorough analysis of the water-port role.

5. Many ports, although certainly not all, are faced with financial constraints. State governments have access to a larger tax base than do local agencies.

6. Many local port authorities are operating through state enabling legislation. In certain states, prior approval by the state is required for local debt financing.

ESTABLISHING A STATE WATER-PORT MASTER PLAN

Each state water-port master plan would be unique. Differences will be caused by study organization, financing, local-state relations, study objectives, and study content. Inasmuch as state involvement in water-port planning should be viewed as complementary to, and not a substitute for, local action, formative efforts in establishing a state water-port master plan should be directed to ensuring a substantive role for local agencies. States should not preempt local options, and statewide planning should build on the efforts of local port authorities. Kester, in evaluating Missouri's statewide waterborne commerce and port development plan (5, p. 8), concludes the following:

> Aggressive local interest and financial commitment stand behind nearly all successful river ports. Without local support most port development efforts have failed. In addition, the presence of a skilled port director during early stages of planning and development has been crucial to fledgling port authorities.

Objectives

Among the problems that confront the states are port congestion; obsolescence of facilities; availability of waterfront property suitable for marine terminal use; low levels of shipping service; land use conflicts; inadequate waterway, terminal, and/or hinterland transportation capacity; and economic underdevelopment. Since the nature of the problems and commodity flows and trading patterns differ from state to state, the objectives of a state water-port master plan will likewise vary. Nevertheless, some objectives that would apply to any state water-port plan can be defined:

1. The role of waterborne transportation in the state economy should be defined. Data would be compiled to describe water transportation in the state as it exists, the economic benefits derived from it (such as employment and transportation savings in relation to other modes), and the economic sectors that depend on its availability.
2. The provision of basic and economically viable levels of water transportation service to all regions of the state that depend on it should be ensured. Distribution of energy materials and grain export, for example, might be considered basic services.
3. A mechanism should be provided by which state and local interests can allocate waterfront lands in a manner consistent with future water transportation needs as well as environmental, recreational, industrial, fishing, flood control, and surface transportation needs. Trade-offs among these concerns may be necessary, and the consequences of future actions should be described to the concerned parties.
4. Unnecessary duplication of terminal facilities and uneconomical overlapping of port hinterlands should be discouraged. A corollary objective is to make the state and its ports more competitive with other states.
5. Coordination of marine transportation development with other actions such as rail-line abandonment or upgrading, economic development, highway construction, and location of utilities and industrial plants should be facilitated.
6. A framework should be provided for coordinating the planning efforts of local and regional port authorities and port agencies in adjoining states. Lines of communication should be established and consistent procedures and formats for data collection defined.

Statewide Versus Regional Port Planning

State port planning can proceed in one of several ways depending on the geographic interrelationships among ports. A multistate regional effort might be desirable before a state plan is initiated; this was the approach taken in the Mid-America Ports Study (MAPS), in which port needs in each of 17 states were related to such external factors as lock and dam constraints and regional energy programs. The MAPS findings can now be refined independently by each participating state.

In contrast to MAPS, a regional port study at the substate level may be desirable. New York State undertook such a study of its upstate ports in addition to its participation in the Great Lakes Ports Study. When a group of ports in one general location have complementary interests--or competing interests--a resolution of such substate regional needs precedes the formulation of a comprehensive state plan. A similar rationale applies to the preparation of a bi-state regional plan, such as the study of the Port of Metropolitan St. Louis.

Components of a State Water-Port Master Plan

A four-phase approach to water-port master planning is suggested. These phases are described below.

Definition

The definition phase entails establishing the detailed study methodology and inventorying marine facilities, waterway characteristics, and the related transportation facilities and land uses in and around ports (including potential sites for marine activities). In addition, historical commerce statistics by commodity, volume, mode of hinterland transportation, and origin and destination should be collected. Study regions and subregions should be defined for purposes of analysis and the economics and demographics of these areas tabulated. Interagency coordination should be formalized. The policies and programs of federal, state, and local agencies that have an impact on and/or relate to port development should be identified. Since the economic benefits attributable to port operations will play an important role in preparing recommendations, agreement among study participants in the approach to this aspect of the study should be reached during the early study phases.

Analysis and Forecast

In the analysis and forecast phase, projections of waterborne commerce should be performed in conjunc-

tion with the econometric and demographic forecasts. An analysis of the potential impact of other transportation systems on projected commerce flows will reveal the extent to which external factors may constrain projected growth; these may include characteristics of locks and dams, channels, railroads, highways, and vessels. Estimates of cargo-handling capacity by commodity (e.g., bulk and general cargo) for the study areas should be completed. Study area benefits should be estimated based on commodity and econometric projections.

Requirements

The requirements phase includes estimates of cargo-handling requirements; these are translated into terminal types, land areas, waterfront development costs, and hinterland transportation needs. The impact of projected water-port development actions on recreational, conservation, and other adjacent land uses should be assessed. Based on projected needs, and on the assessment of impacts and estimated economic benefits, alternative institutional mechanisms for carrying out waterfront development programs (including the status quo) should be postulated and evaluated.

Formulation

The formulation of the state water-port master plan requires the following elements:

1. A schedule for port development, including equipment acquisition, land development, facility construction, renovation, or abandonment;
2. A definition of the primary hinterland by cargo type for each port in the study area (for example, general cargo handling may be encouraged at a single port to increase frequency of service, or it may be dispersed to serve local markets, and bulk cargo terminals might be encouraged to locate along a particular river reach and at a particular rail line or highway to facilitate efficient use of transportation facilities);
3. An allocation of waters and waterfront lands for port development, fleeting, conservation, recreational, and other uses, to be undertaken in concert with the CZM plan, if appropriate; and
4. A definition of responsibilities of various agencies for implementing the plan and identification of means of implementation (e.g., development rights and zoning laws, eminent domain, permitting requirements, tax incentives, and funding mechanisms).

CONCLUSIONS

An enlarged state role in water-port development is practical and should be undertaken in coordination with local interests. There is ample precedent for this working partnership, a relationship that can effectively address the financial problems facing the nation's ports.

REFERENCES

1. American Seaports: Changes Affecting Operations and Development. General Accounting Office, Nov. 16, 1979.
2. National Transportation Policies Through the Year 2000. National Tansportation Policy Study Commission, Washington, DC, Final Rept., June 1979.
3. Mid-America Ports Study Executive Report. Tippetts-Abbett-McCarthy-Stratton, New York, June 1979.
4. G. Hall. Study of Upstate New York Public Ports. TRB, Transportation Research Record 669, 1978, pp. 1-4.
5. R.P. Kester. Statewide Waterborne Commerce and Port Development Planning. TRB, Transportation Research Record 669, 1978, pp. 7-10.

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Statistically Based Methods for Efficient Sampling of Inland Waterway Freight Charges

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Preliminary results of work on the estimation of freight charges for commodity movements in the Ohio River Basin are presented. The U.S. Army Corps of Engineers had rate quotations on 875 of the approximately 12 000 movements in the basin and funds to obtain an additional 325. Consad Research Corporation was engaged to apply statistically based analysis to specify the sample that would give the most accurate estimate of freight rates for the given sample size. The traffic universe and original rate quotations were stratified by commodities and annual tonnage. There were 18 commodity strata, each of which was broken down into 3 volume substrata. The original rate quotations were used to calculate the sample size required for each of the 54 cells at several levels of sampling error and confidence intervals. This indicated the additional points needed. These points were also apportioned among the strata on the basis of freight charges to achieve efficiency in estimating total system charges. Points were also allocated among the three cells of each stratum for purposes of statistical reliability. The resulting sampling plan had a projected error of 5-39 percent for each stratum and an error of 12.9 percent for the system as a whole. Mathematical relations were also derived and applied to estimate freight rates for water and alternative overland movements. The methods used should result in greater reliability in the estimation of freight charges.

One aspect of the evaluation of navigation improvements on the inland waterways system by the U.S. Army Corps of Engineers is benefit-cost analysis. A major component of the benefit side of any such calculation is the difference between the freight charges borne by shippers and receivers who use the waterway mode and freight charges for alternative transportation modes. Such calculations involve estimating freight rates by the waterway mode and by alternative modes of freight transportation. Corps of Engineers planners have developed estimates for many studies, but most of these studies have dealt with a single navigation project. In order to evaluate projects within the context of the systems of which they are a part, there is a need to apply system-analysis methods.

This need has been clearly recognized by the

Table 1. Consad commodity stratification.

Consad Commodity Stratum	Corps of Engineers Commodity Group	Commodity	Rate ($/ton-mile) Amount	Mean	SD
1	1	Coal and lignite	0.021	0.0215	0.0375
2	2	Gasoline	0.008	0.0099	0.0126
	2	Kerosene	0.010		
	2	Distillate fuel oil	0.011		
3	2	Jet fuel	0.006	0.0064	0.0020
	2	Residual fuel oil	0.006		
	2	Liquified gases	0.005		
	9	Lubricating oils and greases	0.006		
	9	Naptha, mineral spirits, solvents	0.006		
	6	Crude products from petroleum	0.007		
	1	Coke, including petroleum coke	0.006		
4	3	Crude petroleum	0.0046	0.0046	0.0008
5	4	Sand, gravel, crushed rocks	0.0137	0.0137	0.0351
6	9	Structural clay products	0.007	0.0082	0.0097
	6	Synthetic rubber	0.010		
	6	Alcohols	0.008		
	6	Benzene and toluene	0.006		
	6	Sulfuric acid	0.009		
	6	Basic chemicals and products	0.008		
	9	Asphalt, tars, and pitches	0.008		
	9	Petroleum and coal products	0.009		
7	6	Gum and wood chemicals	0.005	0.0045	0.0006
	6	Nitrogenous chemical fertilizer	0.005		
	6	Fertilizers and fertilizer material	0.004		
	6	Potassic chemical fertilizers	–		
	6	Phosphatic chemical fertilizers	–		
8	7	Bauxite ore and concentrates	0.004	0.0043	0.0016
	7	Manganese ore and concentrates	0.005		
	7	Nonferrous metal ores and concentrates	0.003		
	8	Iron ore and concentrates	0.003		
	4	Limestone flux and calcareous stone	0.005		
	7	Clay ceramic and refractory materials	0.004		
	7	Salt	0.004		
	7	Liquid sulfur	0.005		
	7	Nonmetallic minerals	0.005		
	9	Lime	0.005		
	9	Slag	0.005		
	7	Copper ore and concentrates	–		
	9	Phosphate rock	–		
9	8	Pig iron	0.007	0.0084	0.0048
	8	Iron and steel ingots	0.008		
	8	Iron and steel pipe and tube	0.009		
	9	Copper and copper alloys	0.008		
9	8	Iron and steel scrap	0.008	0.0084	0.004 8
10	9	Wheat flour and semolina	0.006	0.0051	0.001 2
	9	Tallow, animal fats, and oils	0.004		
	9	Grain mill products	0.007		
	9	Sugar	0.003		
	9	Molasses	0.005		
	9	Prepared animal feeds	–		
	9	Alcoholic beverages	–		
	9	Vegetable oils	–		
11	9	Motor vehicles, parts, and equipment	0.014	0.013	0.001 3
	9	Electrical machinery	0.012		
12	8	Primary iron and steel products	0.013	0.012	0.005 1
	9	Aluminum and aluminum alloys	0.011		
	9	Nonferrous metals	0.010		
13	9	Lead and zinc	0.005	0.0057	0.002 3
	8	Ferro alloys	0.006		
14	9	Pulp	0.005	0.0049	0.000 53
	9	Paper and paper board	0.004		
	9	Basic textile products	–		
	9	Logs	–		
	9	Pulpwood log	–		
	9	Lumber	–		
	9	Standard newsprint paper	–		
15	8	Iron and steel bars	0.024	0.0242	0.071 7
	8	Iron and steel plates and sheets	0.018		
	9	Machinery	0.026		
	9	Fabricated metal products	0.049		
16	9	Building cement	0.016	0.0218	0.031 6
	9	Miscellaneous nonmetallic minerals products	0.017		
	6	Miscellaneous chemical products	0.017		
	6	Sodium hydroxide	0.027		
	9	Rubber and miscellaneous plastic products	–		
	9	Miscellaneous manufacturing products	–		
17	9	Materials used in waterway improvement	0.008	0.0076	0.002 9
	9	Miscellaneous shipments not identified	0.008		
	9	Waste and scrap not elsewhere identified	0.007		
	9	Miscellaneous transportation equipment	0.007		
	9	Ships and boats	–		
	9	Nonferrous metal scrap	–		
18	5	Barley and rye	–	NA	NA
	5	Corn	–		
	5	Oats	–		
	5	Sorghum grains	–		
	5	Wheat	–		
	5	Soybeans	–		
	9	Hay and fodder	–		

Note: SD = standard deviation.

planning staff of the Huntington, West Virginia, District of the Corps of Engineers in its project planning for replacement of the Gallipolis Locks and Dam on the Ohio River. The Huntington District engaged Consad Research Corporation to assist in estimating freight rates for the water mode and alternative modes.

Specifically, the problem is as follows. In 1976, there were 11 747 specific moves of commodities (according to the four-digit Waterborne Commerce Statistical Center code, a commodity classification scheme for waterborne traffic similar to the Standard Transportation Commodity Classification) that involved the port equivalents in the Ohio River Basin [a "port equivalent" (as defined in the Inland Navigation Systems Analysis program of the Corps of Engineers as an aid in water simulation projects) refers to a stretch of river

that has a composite of port characteristics]. The Ohio River Basin consists of the main-stem Ohio River and the Allegheny, Monongahela, Kanawha, Kentucky, Green, Tennessee, Clinch, and Cumberland Rivers. Each move may be represented by a cell in an origin-destination (O-D) matrix. The values in the matrix cells represent the annual tonnage of particular commodities moving between the port equivalents. In 1976, these values ranged from more than 1.35 million tons to as few as 250 tons. O-D matrices of these data were available in computerized form.

The Corps of Engineers obtains rate estimates by engaging knowledgeable traffic-management contractors to provide rate quotations on specific dock-to-dock moves for water transportation, any land leg of a water move, alternative overland means of transportation, and various loading and unloading charges. Several such rate studies have been performed for the Corps of Engineers over the past several years for particular project planning efforts. Those studies provided usable rate quotations for 875 of the 11 747 moves in the Ohio River Basin. Quotations for an additional 274 movements in the upstream portion of the basin were in the process of being developed. The Corps of Engineers planning budget permitted an additional 325 quotations, which would provide an overall coverage of about 12 percent. All of the available rate quotations and those to be obtained were in computerized form, consistent with the traffic data.

The task at hand was to develop a sampling plan for collecting the additional 325 quotations, which would provide the highest degree of statistical reliability in rate estimates.

The study plan then called for the traffic-management contractor to obtain the additional quotations as specified in Consad's sampling plan. Then, by using the total of 1500 rate quotations and the characteristics of the moves rated, Consad developed relations to synthesize the 88 percent of the moves for which rate quotations were not available. Finally, by using both the rate quotations and the synthetic relations, matrices were constructed for waterway rates and rates for alternative modes.

TECHNICAL APPROACH

The system under study lends itself quite well to the application of statistical principles for the selection of additional sample points. Thus, the first step was to stratify the traffic data so as to group moves for sampling. The existing 875 rate samples provided the opportunity to investigate the rate levels and variation in rates that would indicate sampling rates. Therefore, it was important in this first phase of the effort that both the traffic universe and the existing rate sample be stratified by the same factors.

From a knowledge of transportation economic principles and industry practices in rate setting, it was postulated that the factors at work, and thus the stratification of interest, included the following: commodity, distance, annual tonnage, river direction, and number of lockages. However, because both files (existing rate quotations and traffic movements) did not provide usable information on distance, river direction, and number of lockages, these factors were dropped. The files were stratified by commodity and annual tonnage.

The Ohio River Division of the Corps of Engineers uses a commodity stratification that consists of the nine groups given below:

Commodity Group	Rate ($/ton-mile) Mean	SD
Coal and coke	0.021	0.037
Petroleum fuels	0.0087	0.0105
Crude petroleum	0.0046	0.0008
Aggregates	0.0135	0.0346
Grains	-	-
Chemical and chemical fertilizers	0.0094	0.0150
Ores and minerals	0.0043	0.0017
Iron ore and steel	0.0136	0.0461
All other	0.0122	0.0353
Total	0.0127	0.0304

Consad initially grouped the rate sample in this way and analyzed the values for rate per ton-mile for the four-digit commodities within each group. By inspection and statistical analysis, it was found that rate per ton-mile showed considerable variation within the groups. The table above gives the means and standard deviations found for the nine groups. Comparison of within-group variances with between-group variances indicated that there might be a better grouping of the sample. In regrouping the data, we looked for a grouping in which the variance within strata was reduced and the variance between strata was increased. Through inspection and application of analysis of variance, the data were restratified into the 18 commodity strata given in Table 1.

The next step was to substratify by annual volume. In this case, we relied largely on judgment and chose three cells, each of which includes moves that constitute approximately one-third of the tonnage in each stratum. This required that the movements in each stratum be rank ordered by annual tonnage and then accumulated so as to split the tonnage into thirds. The first cell includes the largest moves in the stratum and the third the smallest. The substratification of the traffic universe is indicated in the table below, which gives the number of moves in each cell:

Stratum	Number of Moves by Annual Volume: Top Third	Middle Third	Bottom Third	Total
1	25	80	1339	1444
2	34	118	1000	1152
3	26	120	691	837
4	4	9	32	45
5	20	80	1070	1170
6	21	106	973	1100
7	19	83	198	300
8	10	82	706	798
9	57	195	439	691
10	13	71	284	368
11	2	4	36	42
12	2	14	66	82
13	6	50	184	240
14	1	2	37	40
15	103	360	1122	1585
16	8	19	191	218
17	7	27	240	274
18	56	245	1060	1361

It should be noted that, as a whole, small moves (the bottom third of the tonnage in each stratum) make up 82 percent of the movements in the universe of traffic.

The next step was to determine the appropriate sample size for each of the 54 cells. Once again, statistical principles were applied and all available information was used in sample design. This was accomplished by stratifying the existing

Table 2. Required sample size by cell.

Stratum	Cell	Points in Sample	10 Percent Error: Required Number of Samples	10 Percent Error: Additional Points	20 Percent Error: Required Number of Samples	20 Percent Error: Additional Points
1	1	8	25	17	23	15
	2	24	71	47	52	28
	3	143	519	376	183	40
2	1	15	33	18	31	16
	2	33	54	21	21	–
	3	57	101	44	28	–
3	1	15	14	–	6	–
	2	34	22	–	7	–
	3	43	26	–	7	–
4	1	0	3	3	2	2
	2	2	1	–	1	–
	3	3	2	–	1	–
5	1	4	12	8	5	1
	2	22	30	8	11	–
	3	69	719	650	362	293
6	1	12	7	–	2	–
	2	54	90	36	62	8
	3	81	211	130	63	–
7	1	1	5	4	2	1
	2	3	3	–	1	–
	3	1	7	6	2	1
8	1	11	7	–	4	–
	2	27	14	–	4	–
	3	34	47	13	13	–
9	1	12	7	–	2	–
	2	9	8	–	2	–
	3	23	89	66	27	4
10	1	1	6	5	3	2
	2	0	13	13	4	4
	3	5	15	10	4	–
11	1	0	2	2	1	1
	2	0	2	2	1	1
	3	2	3	1	1	–
12	1	0	2	2	2	2
	2	0	11	11	7	7
	3	4	29	25	11	7
13	1	3	1	–	1	–
	2	4	32	28	16	12
	3	12	32	20	10	–
14	1	0	1	1	1	1
	2	0	2	2	1	1
	3	3	3	–	1	–
15	1	14	19	5	6	–
	2	16	20	4	6	–
	3	40	690	650	320	280
16	1	4	8	4	7	3
	2	5	19	14	18	13
	3	11	41	30	12	1
17	1	0	6	6	5	5
	2	0	16	16	8	8
	3	9	33	24	10	1
Total		873	3133	2322	1380	758

rate sample in the same pattern as the traffic universe and calculating variances in rate per ton-mile within each cell. Then, the sample size was determined for each cell, assuming error levels of 10 and 20 percent and 67, 90, and 95 percent confidence intervals by using the following relationship:

$$n_i = N_i(S_i^2 Z^2)/(N_i e_i^2 + S_i^2 Z^2) \quad (1)$$

where

n_i = number of movements to be sampled for cell i,
N_i = number of movements in the universe in cell i,
S_i^2 = estimated variance of rate per ton-mile for cell i,

Table 3. Tonnage and freight charges by stratum.

Stratum	Annual Volume (millions of tons)	Percentage of Tonnage	Annual Freight Charges: Millions of Dollars	Annual Freight Charges: Percent
1	102.990	57.8	199.799	40.7
2	14.832	8.3	72.888	14.8
3	6.836	3.8	46.590	9.5
4	0.883	0.5	4.213	0.8
5	19.899	11.2	32.436	6.6
6	8.587	4.8	37.355	7.6
7	1.058	0.6	9.798	2.0
8	6.203	3.5	33.592	6.8
9	1.197	0.7	9.216	1.9
10	1.222	0.7	7.811	1.6
11	0.028	0.01	0.422	0.09
12	0.159	0.09	1.470	0.3
13	0.627	0.3	4.919	1.0
14	0.512	0.3	3.497	0.7
15	1.949	1.1	15.266	3.1
16	1.817	1.0	5.256	1.1
17	3.907	2.2	6.133	1.2
18	5.384	3.0	–[a]	–[a]
Total	178.090		490.661	

[a]Not included in total.

Table 4. Points indicated and justified by stratum.

Stratum	Points Required for 90 Percent Confidence and Error of: 10 Percent	20 Percent	Points in Existing Sample	Additional Points Indicated: 10 Percent	20 Percent	Justified
1	615	258	175	440	83	128
2	188	80	105	83	–	47
3	62	20	92	–	–	30
4	6	4	5	1	–	3
5	761	378	95	666	283	21
6	308	127	147	161	–	24
7	15	5	5	10	–	6
8	68	21	72	–	–	22
9	104	31	44	60	–	6
10	34	11	6	28	5	5
11	7	3	2	5	1	0
12	42	20	4	38	16	1
13	65	27	19	46	8	3
14	6	3	3	3	–	2
15	729	332	70	659	262	10
16	68	37	20	48	17	3
17	55	23	9	46	14	4
18	–	–	0	–	–	10
Total	3133	1380	873	2294	689	325

e_i = acceptable error in the estimate of rate per ton-mile for cell i (the error is a fixed percentage of the rate, such as 10 or 20 percent), and
Z = normal distribution statistic that specifies a specific level of confidence (Z = 1.645 for a 90 percent confidence level).

Table 2 gives the sample size required for a 90 percent confidence level. To achieve a 10 percent error in all cells would require a total of 3133 rate samples, which amounts to 2322 additional sample points. Even a 20 percent error level would require 758 additional points (planning funds were available for 325 points).

The next step was to search for a decision rule by which to allocate the 325 new sample points to the 54 cells. It is important to note that there is wide variation among the strata in the amount of traffic included within each cell. Data given in

Table 3 show that stratum 1 (coal and lignite) includes 103 million tons (58 percent of the total tonnage) whereas the smallest stratum, stratum 11 (motor vehicles, parts, and equipment and electrical machinery) contains only 28 000 tons. Thus, a 10 percent error in stratum 1 is much more critical to the overall effort than such an error in stratum 11. Further consideration of the objectives of the study focused on the factor of concern in the benefit-cost analysis, which is not tonnage but freight charges. The transportation benefits used in the benefit-cost analysis are actually the difference in system total freight charges for transportation by waterway and transportation by alternative overland modes.

By using the mean rates from the rate sample and the total system tonnages from the traffic file, the estimated freight charges attributed to each stratum were calculated. As the data in Table 3 show, although the first stratum (coal and lignite) represents 58 percent of the tonnage, it accounts for only 41 percent of the system freight charges. Conversely, stratum 2 (gasoline, kerosene, and distillate fuel oil) represents only 8.3 percent of the tonnage but, mostly because of length of haul, accounts for 14.8 percent of the system freight charges.

Freight charges provide the rule for apportioning the additional sample points. That is, the 325 points should be selected from among the strata in proportion to each stratum's percentage of freight charges in the traffic universe.

Since there were no rate quotations available for stratum 18 (grain), its points were selected on the basis of tonnage (3 percent), and 10 points were chosen for that stratum. The remaining 315 points were allocated in proportion to freight charges.

Table 4 gives the indicated sample points for each stratum. It shows large discrepancies in some strata (e.g., 1, 5, and 15) between the number of points required to attain 10 percent error and the number of points that can be justified on the basis of planning efficiency. It should be noted that many of the points indicated actually fall within the third cell of each stratum, in which there are very large numbers of movements.

The justified points must also be allocated to the three cells in each stratum. It was reasoned that, because of the smaller number of moves in the first cell of each stratum, a rate quotation from that cell will always be more valuable in the sense of added statistical reliability than one from the second or third cell. In the same way, it will be more effective to select a point from the second than from the third cell of any stratum. Therefore, it was decided that in each stratum the allocated points will be assigned to cells 1, 2, and 3, respectively, to the level justified by a 10 percent error and a 90 percent confidence level.

The 325 additional points were thus assigned to each cell. For the 18 strata, the first cell was always assigned sufficient points to yield a projected 10 percent error.

PERFORMANCE OF THE SAMPLING PLAN

The performance of the sampling plan can be projected by assuming that the means and standard deviations of the ultimate rate sample are the same as those of the initial rate sample. The table below gives the projected percentage and dollar-valued error in freight charges by stratum:

	Projected Error at 90 Percent Confidence	
Stratum	Percentage of Rate	Freight Charges ($000 000s)
1	12.8	25.587
2	10.9	7.967
3	7.9	3.680
4	5.3	0.223
5	24.1	7.841
6	12.9	4.815
7	10.4	1.018
8	5.0	1.707
9	11.6	1.068
10	15.4	1.214
11	10.5	0.044
12	39.0	0.574
13	17.2	0.847
14	10.7	0.375
15	29.1	4.437
16	14.2	0.745
17	18.7	1.147
18	-	-
Total	12.9	63.289

These data indicate that there is substantial variation in error among the strata. Yet this is a near-optimal situation for allocation of the 325 sample points from the viewpoint of minimizing error in estimates of freight charges for the system as a whole.

Based on these data, it can be projected that, with an additional 325 sample points, system total freight charges can be estimated with 90 percent confidence to within 12.9 percent of the actual value.

SAMPLE SELECTION

The final step in the sampling plan was to select the actual commodity-origin-destination movements to receive rate quotations. This involved random ordering of the movements in each of the 54 cells and selection from that list. Sufficient moves were selected in each cell to allow replacement of any moves on which quotations could not be obtained. The Corps of Engineers then requested that the traffic-management contractor develop rate quotations specified by origin-destination-commodity in the Consad sampling plan.

SYNTHESIS OF RATE ESTIMATES

In addition to selecting the supplemental rate sample, Consad was charged with developing estimates of rates for the 90 percent of the movements for which rate quotations were not available. Although this work is still being done and has not received Corps of Engineers review, preliminary results can be presented here as work in progress.

The Consad approach to this task has been to apply multiple regression analysis to movements in the rate sample in order to develop relations between unit barge rates as dependent variables and a series of independent variables. A total of 1502 rate samples were available for use. These included the 875 previously analyzed during supplemental sample selection, 274 additional samples subsequently obtained from upper-basin studies, the 325 samples selected by Consad, and additional grain samples drawn by the Corps of Engineers. The unit barge rates were expressed as both rate per ton and rate per ton-mile. The independent variables considered were mileage (rate per ton only), annual tonnage, and three variables that reflect the effort involved in moving traffic between two points on the inland waterway system (changes of elevation between the two pools, river direction in terms of

Table 5. Results of regression analysis by stratum for waterway rate per ton.

Commodity Stratum	Number of Sample Points	Percentage of Total Tonnage	Significant Variables at 95 Percent Confidence	R^2
1	389	58.1	Mileage	0.93
2	87	2.9	Mileage	0.73
3	239	9.0	Mileage, annual tonnage	0.96
4	6	0.5	Annual tonnage, mileage	0.96
5	161	12.5	Mileage	0.90
6	100	2.3	Mileage, number of lockages	0.97
7	103	3.0	Mileage	0.84
8	24	0.6	Mileage	0.74
9	95	2.7	Mileage, annual tonnage	0.54
10	33	0.4	Mileage	0.75
11	50	0.6	Mileage	0.59
12	99	1.1	Mileage, river direction	0.17
13	6	0.02	Mileage, number of lockages	0.98
14	18	0.1	River direction	0.32
15	6	0.3	Mileage	0.75
16	26	0.7	Mileage	0.68
17	9	2.1	Mileage, elevation	0.68
18	51	3.0	Mileage	0.72

percentage of the move that is upriver, and the number of lockages between origin and destination).

It can be postulated that there are other factors that affect barge rates or reflect variation in such rates. However, a necessary condition in this analysis was that the independent variables be available in both the rate analysis and the traffic universe. After some data development and coding, all five variables mentioned above met that condition.

Regression analysis was applied to the points in the rate sample as broken down into the 18 strata. In most cases, the results for rate per ton were quite good. As the data given in Table 5 indicate, the R^2 values for the major commodity strata are high. In fact, the 8 strata with R^2 values in excess of 90 percent account for more than 87 percent of the tonnage and more than 70 percent of freight charges. More than 94 percent of the tonnage (which accounts for more than 90 percent of the freight charges) is in strata with R^2 values greater than 75 percent.

An analysis in which rate per ton-mile was used as the dependent variable was much less successful and was not carried further.

The chosen regression relations for rate per ton-mile for the top five commodity strata (1, 3, 5, 7, and 18) are as follows for stratum 1,

$$RPT = 0.722 + 0.004\,41 \cdot \text{mileage} \quad (R^2 = 0.93) \tag{2}$$

for stratum 3,

$$RPT = 1.629 + 0.0052 \cdot \text{mileage} - 3.156 \cdot \text{annual tonnage} \quad (R^2 = 0.96) \tag{3}$$

for stratum 5,

$$RPT = 0.731 + 0.005\,05 \cdot \text{mileage} \quad (R^2 = 0.90) \tag{4}$$

for stratum 7,

$$RPT = 0.933 + 0.0055 \cdot \text{mileage} \quad (R^2 = 0.84) \tag{5}$$

and for stratum 18,

$$\ln(RPT) = -3.392 + 0.749 \cdot \ln(\text{mileage}) \quad (R^2 = 0.72) \tag{6}$$

where RPT = rate per ton.

These preliminary findings indicate that the effort to reliably synthesize rates for the 90 percent of the movements for which quotations are not available should be successful. This result also shows the consistency in barge rates.

Consad's efforts for the Corps of Engineers also involved similar analysis of overland rates. Those results are too preliminary to present at this time, but it can be reported that the results in terms of the ability to fit a regression equation to the rates were much less successful. The structure of overland rates for commodities that currently move by waterway appears to be much more complex than that of waterway rates and to involve factors that could not be captured by using the data available for this study.

CONCLUSION

The effort described in this paper represents application of well-established statistical analytic methods and transportation planning principles in the development of a sampling plan for estimating freight rates for movement of traffic in the Ohio River Basin. These methods should result in a higher level of reliability in estimates of freight charges than could be expected with the same investment of planning resources in the absence of such methods.

Preliminary findings on the synthesis of rates for nonsampled movements indicate that high levels of reliability can be expected in relationships developed for waterway rates. Less reliability can be expected for rates developed for alternative overland movements.

ACKNOWLEDGMENT

The work reported here was performed under contract to the Huntington District of the U.S. Army Corps of Engineers. It is part of a cooperative effort of the Huntington, Louisville, Nashville, and Pittsburgh Districts in compiling an Ohio River Basin-wide rate matrix. The planning staff of the Huntington District has taken the lead in this effort, including conceptualization of the overall plan and development of data formats and procedures for compiling rate quotations. The traffic-management firm of Charles Donley and Associates developed the rate quotations that form the basis for the basinwide rate matrix. Consad has performed the sample design and the analytic work involved with expanding the sample to the basinwide level. The development of the basinwide rate matrix represents a major advancement in the economic evaluation component of waterway system analysis and will become an integral tool in evaluation at both the project and system levels of analysis.

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Tenants of Foreign Trade Zones

JOHN H. LEEPER

Foreign trade zones have become increasingly popular in the United States and are often the responsibility of inland port managers. The key to a successful operation is finding and obtaining the tenants who are the individuals and corporations that lease space and perform activities within the zones. Examples of the use of foreign trade zones, including the names of corporations and the types of activities they conduct, are presented. Suggestions for identifying and attracting tenants, as well as useful data bases for analyzing foreign-trade-zone potentials, are provided. Finally, comments are made on the future and impact of foreign trade zones.

A foreign trade zone is defined in the Code of Federal Regulations as

> an isolated, enclosed, and policed area, operated as a public utility, in or adjacent to a port of entry, furnished with facilities for lading, unlading, handling, storing, manipulating, manufacturing, and exhibiting goods, and for reshipping them by land, water, or air. Any foreign and domestic merchandise, except such as is prohibited by law or such as the Board may order to be excluded as deterimental to the public interest, health, or safety may be brought into a zone without being subject to the customs laws of the United States governing the entry of goods or the payment of duty thereon; and such merchandise permitted in a zone may be stored, exhibited, manufactured, mixed or manipulated in any manner, except as provided in the act and other applicable laws or regulations. The merchandise may be exported, destroyed, or sent into customs territory from the zone, in the original package or otherwise. It is subject to customs duties if sent into customs territory, but not if reshipped to foreign points.

The foreign trade zone concept had its origins in Europe during the Middle Ages. As trade restrictions developed during the growth of mercantilism, a system of free ports evolved. Under this system, cities such as Hamburg and Venice were exempted from the normal tariffs and customs regulations of their respective countries. Later, as an alternative to exempting entire cities, free zones were established within city boundaries. Now, the terms free zone and free port are often used interchangeably. In the United States, the term foreign trade zone has become the standard term for a free zone.

Free zones have been a source of public policy debate in the United States since the 1890s, when the U.S. Senate rejected the first in a long series of proposed free-zone legislation. Finally, in 1934, the Foreign Trade Zone Act was signed into law, and foreign trade zones became a part of the U.S. international trade system. Only seven zones were approved between 1934 and 1952, and three of these later surrendered their operating grants. The original remaining four are New York, New Orleans, San Francisco, and Seattle.

Of the 45 authorized U.S. foreign trade zones that exist today, only 7 were approved prior to 1970. Clearly, the rush in foreign trade zones has occurred in the decade of the 1970s. Foreign trade zones are appearing with increasing frequency in inland river and Great Lakes locations, and port authorities are typical foreign-trade-zone grantees. Table 1 lists the 45 approved sites, and Figure 1 shows the site locations as of July 1979.

The object of establishing a foreign trade zone is to attract economic activity consistent with national policy. Ideally, this activity should not replace existing domestic employment but rather repatriate overseas operations of U.S.-based multinationals, attract foreign direct investment to the United States, or encourage domestic firms to expand their international trade activity. Tenants of foreign trade zones are usually commercial enterprises that conduct manufacturing, exhibition, storage, or distribution functions within zones. Tenants can range from small import-export companies to large multinational manufacturing organizations.

Attracting and retaining tenants or users are perhaps the most critical and least understood of the various elements involved in establishing and managing a foreign trade zone. Most professionals in foreign-trade-zone management would agree that tenants are the key to a successful operation. Without at least one high-quality, long-term tenant, a foreign trade zone will struggle through a fitful existence, if in fact it survives at all.

The purpose of this paper is to explain the relationship between tenants and foreign trade zones, to identify typical tenant industries, and to suggest the ways and means for attracting and retaining quality tenants.

WHY THE FOREIGN TRADE ZONE

Tenants or users are attracted to foreign trade zones because of specific advantages that can be gained in reducing costs or otherwise facilitating a manufacturing or distribution process. During the 1970s, international trade and commerce changed rather dramatically through the growth of multinational firms. Today, international multiplant manufacturing processes, together with international licensing agreements, have led to the development of truly international products, many of which use components from a variety of nations. As a result, many companies have been attracted to foreign trade zones as a means of reducing the costs of manufacturing and distribution.

Specifically, foreign trade zones are used for six types of commercial activity:

1. Storage--Foreign goods may be stored in the zone as long as necessary without paying customs duties;
2. Exhibition--Goods may be displayed, inspected, and sampled in the zone without payment of customs duties;
3. Quotas--Import quotas do not apply to the zone, so goods can be stored without customs duty until a subsequent quota period, or they can be processed into another commodity not subject to quota;
4. Manipulation and processing--Since duty is levied only on goods entering the United States, products can be sampled, tested, cleaned, cut, and repacked in the zone and, finally, brought into the country in a form subject to a lower duty;
5. Manufacturing and assembly--Foreign parts and subassemblies can be combined with U.S. parts and raw materials by using U.S. labor to produce goods that can be entered into the United States (or shipped overseas) at a lower cost because of the reduced customs duties that result when the product

Table 1. Approved U.S. foreign trade zones and reserved sites as of July 1979.

Location	Year Established	Zone Number
New York, NY	1937	1
New Orleans, LA	1947	2
San Francisco, CA	1948	3 and 3-A
Seattle, WA	1949	5
Mayaguez, PR	1961	7
Toledo, OH	1960	8
Honolulu, HI	1965	9 and 9-A
Bay County, MI	1972	10
McAllen, TX	1973	12
Little Rock, AK	1973	14
Kansas City, MO	1973	15
Sault Saint Marie, MI	1973	16
Kansas City, KA	1973	17
San Jose, CA	1974	18
Omaha, NB	1975	19
Portsmouth, VA	1975	20
Dorchester County, SC	1975	21
Chicago, IL	1975	22
Buffalo, NY	1976	23
Wilkes-Barre/Scranton, PA	1976	24 and 24-A
Port Everglades, FL	1976	25
Shenandoah, GA	1977	26
Boston, MA	1977	27
New Bedford, MA	1977	28
Louisville, KY	1977	29
Salt Lake City, UT	1977	30
Granite City, IL	1977	31
Miami, FL	1977	32
Pittsburgh, PA	1977	33 and 33-A
Niagara City, NY	1977	34
Philadelphia, PA	1978	35
Galveston, TX	1978	36
New Windsor, NY	1978	37
Greenville-Spartanburg, SC	1978	38
Dallas-Fort Worth, TX	1978	39
Cleveland-Cuyahoga City, OH	1978	40
Milwaukee, WI	1978	41
Orlando, FL	1978	42
Battle Creek, MI	1978	43
Lakeland-Morris County, NJ	1978	44 and 44-A
Portland, OR	1978	45
Cincinnati, OH	1979	46, 46A, and 46B
Campbell City, KY	1979	47
Papago-Tucson, AZ	1979	48
Newark-Port Elizabeth, NJ	1979	49
Phoenix, AZ	Reserved	
Long Beach, CA	Reserved	
Oakland, CA	Reserved	
Islip, NY	Reserved	
Boonville, MO	Reserved	

changes form (in many instances, the combined duties on parts are more than the duty on the finished product); and

6. Accelerated export--Goods moved into the zone from the United States are considered exported when they enter the zone, which can accelerate duty rebates under customs drawback procedures.

Given these typical uses, when does a potential tenant decide that the use of a foreign trade zone is in its best interests? The number of potential situations, products, and companies is almost unlimited. However, the following are some of the more typical situations:

1. High volumes of imports are held as inventory and then distributed in the United States. By storing and distributing goods from a zone, the customs duties can be delayed and the interest charges on borrowed working capital can be eliminated. For instance, merchandise ordered for Christmas sale can be stored in and distributed from a zone.

2. Higher customs duties are levied on parts than on the finished products. If a product is already being assembled in the United States from a variety of internationally produced components, the cost of production can often be lowered by the difference in customs duties. For instance, there are no duties on imported agricultural tractors, but there are duties on tractor parts. Assembly in the United States from foreign components is therefore more advantageous in a zone.

3. Supplies are being provided to foreign-bound ships and airplanes. If products imported into the United States are then sold to foreign-bound ships and airplanes, the customs duties can be eliminated altogether by distributing them from a zone. For instance, liquor for cruise ships is often distributed from a zone.

4. Indefinite storage of high-value imported products is required. If an importer needs extraordinary security, the zone can provide protected space at a reasonable cost and often at reduced insurance costs. For instance, a sophisticated machine may have been ordered for a construction project long before it was needed because of the favorable price. Until it is needed,

Figure 1. Locations of U.S. foreign trade zones as of July 1979.

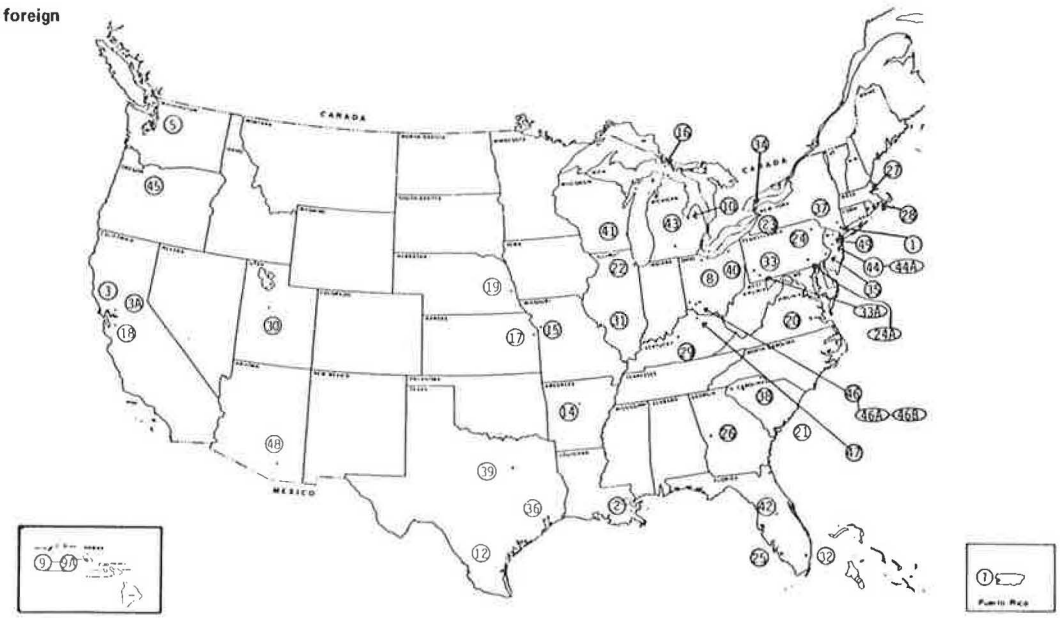

Table 2. Typical foreign-trade-zone tenant industries.

Tenant Industry	Zone	Country of Origin	Activity
Drugs and food additives	Battle Creek	Various	Store
Powdered milk	Battle Creek	Various	Store
Surgical instruments	Battle Creek	Japan	Reexport
Steel fabricator	Buffalo	Japan	Reexport
Leather goods	Buffalo	Italy	Reexport
Plastics	Buffalo	Canada	Reexport
Copying equipment	Buffalo	Various	Inspect and reexport
Whisky distiller	Chicago	Various	Store
Motorcycle manufacturer	Chicago	Japan	Assemble
Chemicals	Kansas City	West Germany	Reexport
Furniture	Kansas City	Hong Kong	Store and assemble
Luggage	Kansas City	Korea	Store and assemble
Film	Kansas City	Japan	Store and assemble
Wine	Kansas City	Portugal	Store and assemble
Aircraft engines	Kansas City	Canada	Store and assemble
Vacuum-cleaner distributor	Portland	Japan	Store
Oriental artifacts	San Francisco	China	Store and assemble
Liquor distributor	Seattle	Various	Store and distribute
Fishing tackle	Seattle	Japan	Store and distribute
Diesel manufacturer	Toledo	Various	Manufacture
Zinc smelting	Toledo	Various	Manufacture
Electronics manufacturer	Wilkes-Barre/ Scranton	Various	Store and reexport
Typewriter manufacturer	Wilkes-Barre/ Scranton	Italy	Subzone
Outboard-motor manufacturer	New York	Various	Store and distribute
Electronics manufacturer	New York	Japan	Store and distribute
Automobile manufacturer	Pittsburgh	West Germany	Manufacture

it can be stored in the zone without concern about pilferage.

5. Goods that require inspection and quality control and resultant shipment command a lower duty. For instance, an importer may bring in large quantities of untested electronic components. By testing them in a zone, the importer then accepts only the usable components and does not pay duties on the entire batch.

WHO THE TENANTS ARE

The tenants or users of foreign trade zones represent a cross section of the American free enterprise system. They range from major multinational firms such as Volkswagen to an individual citizen who may want to store a product purchased overseas. Table 2 gives examples of typical tenant industries that are using foreign trade zones throughout the United States and the products and goods that are being handled.

Tenants of U.S. foreign trade zones currently include many of the largest U.S. and international manufacturing and distributing corporations. Among these are Lear Jet; Control Data Corporation; Rockwell International; Hughes Aircraft; International Business Machines; Samsonite; Motorola; General Foods Corporation; Bristol Laboratories; Sears, Roebuck, and Company; Heublein, Inc.; Almaden Vineyards; McCormick Distillers, Inc.; Clorox Company; Ford Motor Company; General Mills; H. J. Heinz Company; Pillsbury; Mobil Oil; Evinrude Motors; Sony of Japan; RCA; and Uniroyal International.

However, in addition to well-known multinational corporations, there are hundreds of small companies and individuals who use foreign trade zones, some on a continuing basis and others only for single transactions.

Tenants for foreign trade zones have not always been plentiful. For instance, the New York foreign trade zone (zone 1) experienced many years of marginal operation from its inception in 1937 to the early 1970s. Now more than 100 business firms are tenants or users of zone 1, and it is 90 percent occupied as compared with 65 percent in 1975. New York has benefited from its location and natural role as an international trading center.

The subzone concept has increased potential tenant interest in using a foreign trade zone. A subzone is an enclosed and protected area located away from the main foreign trade zone. It is usually part of an existing manufacuturing plant in which normal production operations are under way. The obvious benefit is that a manufacturer is able to conduct normal operations without relocating and still take advantage of the foreign trade zone. Each subzone is under the management of a parent foreign trade zone that is responsible for its operation. Recent examples of commercial operations using subzones are Volkswagen under the Pittsburgh zone (zone 33) and Olivetti under the Wilkes-Barre/Scranton zone (zone 24).

RELATIONSHIP BETWEEN THE GRANTEE OR OPERATOR AND THE TENANT

The grantee is the organization that applies for and receives a grant to operate a foreign trade zone. An operator conducts the actual operation of the zone. The grantee and the operator can be, and often are, the same organization.

The initiative to establish a foreign trade zone frequently comes from state and local officials who are eager to undertake high-visibility programs for economic development. For example, a recent New Jersey newspaper article observed that the state was now concentrating on developing three foreign trade zones as a stimulus for creating manufacturing jobs.

Unfortunately, some of these local and state officials do not look beyond the award of the foreign-trade-zone grant. Federal assistance is often available to hire consultants and staff to prepare a foreign-trade-zone application, and it is not uncommon for the application to be granted to a grantee that has no firm tenants and little concept of how to attract them. Although it is true that there must be letters of intent from potential tenants in the application to the Foreign-Trade Zones Board, there is no way to enforce the letter of intent once the zone is in operation. In many cases, firms that have expressed interest fail to follow through.

The grantee-operator and the tenant often make strange bedfellows. The Foreign-Trade Zones Board requires that zones be planned and operated as public utilities, and it states that zones are not intended to be profit ventures for sponsors. On the other hand, the tenant is usually a commercial enterprise and can be attracted into a foreign trade zone only through the potential for improved profit, usually through reduced production and distribution costs.

The difficulty arises when the grantee--usually a quasi-governmental corporation or agency--fails to realize that it is in a highly competitive market in which the buyers (potential tenants) are sophisticated, profit-oriented businessmen. The grantee-operator has to provide a service and environment that are competitive with other foreign trade zones, both in the United States and abroad, and must have the tenants' current and long-term profitability firmly in mind. Obviously, great care must be exercised in selecting the zone operator.

Table 3. Census data by market and commodity for 1979 Wisconsin imports.

Country of Origin	Commodity	Pounds (000s)	Value		Shipping Category (%)			
			Dollars (000s)	Dollars per Pound	Container	Bulk	Cargo	Other
Great Britain	678 Iron or steel tubes, fittings	5 282.5	751.5	0.12	0	0	100	0
	685 Lead and lead alloys	662.0	340.2	0.51	79	0	0	20
	698 Manufactures of metal	465.1	396.0	0.85	100	0	0	0
	711 Power generating machinery	178.9	477.7	2.67	99	0	0	0
	712 Agricultural machinery, etc.	595.4	798.4	1.34	100	0	0	0
	715 Metalworking machinery and parts	656.5	239.0	0.36	100	0	0	0
	718 Machinery for special industry	735.8	477.8	0.65	100	0	0	0
	719 Machinery and appliances[a]	779.9	437.8	0.63	100	0	0	0
	729 Electrical machinery[b]	12.9	23.9	1.85	0	0	93	0
	732 Road motor vehicles and parts	6 904.8	2 432.9	0.35	100	0	0	0
	821 Furniture	24.3	239.1	9.84	99	0	0	0
	841 Clothing, etc., not fur	0.3	10.3	34.33	0	0	0	0
	Total	56 857.7	11 928.4	0.21	22	0	77	0
Haiti	061 Sugar, syrups, molasses, honey	1 720.8	25.0	0.01	0	0	0	100
	Total	1 720.8	25.0	0.01	0	0	0	100
Honduras	051 Fruits, fresh	1 173.0	41.4	0.04	100	0	0	0
	Total	1 173.0	41.4	0.04	100	0	0	0
Indonesia	231 Rubber, crude	9 099.5	2 981.5	0.33	0	0	100	0
	Total	9 099.5	2 981.5	0.33	0	0	100	0
Ireland	851 Footwear	148.2	579.2	3.91	99	0	0	0
	Total	148.2	579.2	3.91	99	0	0	0
Italy	712 Agricultural machinery, etc.	0	477.8	0	0	0	0	0
	Total	0	477.8	0	0	0	0	0
Ivory Coast	072 Cocoa	512.3	325.1	0.63	0	0	100	0
	Total	512.3	325.1	0.63	0	0	100	0
Japan	032 Fish, airtight container[a]	884.4	312.8	0.35	100	0	0	0
	053 Nuts and fruits[b]	1 070.9	225.9	0.21	100	0	0	0
	581 Plastic materials, synthetic resins	5 164.7	3 378.6	0.65	100	0	0	0
	532 Wood manufactures[a]	10 939.4	7 070.6	0.65	43	0	0	57
	655 Special textile fabrics, inclusive	738.8	152.5	0.21	0	0	0	100
	672 Iron or steel primary forms	6 282.6	707.5	0.11	0	0	100	0
	674 Iron or steel plates and sheets	9 716.0	3 767.3	0.39	0	24	76	0
	678 Iron or steel tubes, fittings	14 473.4	5 792.7	0.40	0	0	100	0
	711 Power generating machinery	4 654.9	11 717.6	2.52	100	0	0	0
	717 Textile and leather machinery	6 281.9	7 044.4	1.12	0	0	100	0
	718 Machine for special industry	5 164.7	2 623.9	0.51	100	0	0	0
	719 Machinery and appliances[a]	7 026.6	8 186.5	1.17	100	0	0	0
	Total	72 398.3	50 970.4	0.70	40	3	48	10
Malaysia	075 Spices	2 073.0	1 492.9	0.72	0	0	0	100
	231 Rubber, crude	1 070.6	195.9	0.18	0	100	0	0
	687 Tin and tin alloys	465.4	1 300.7	2.79	0	0	100	0
	Total	3 609.0	2 989.5	0.83	0	30	13	57
Morocco	075 Spices	774.7	176.4	0.23	0	0	100	0
	Total	774.7	176.4	0.23	0	0	100	0
Netherlands	013 Meats in containers[b]	4 655.0	6 408.3	1.38	100	0	0	0
	719 Machinery and appliances[a]	53.9	238.9	4.43	98	0	0	0
	Total	4 708.9	6 647.2	1.41	100	0	0	0
Nigeria	072 Cocoa	228.0	117.1	0.51	0	100	0	0
	Total	228.0	117.1	0.51	0	100	0	0

[a]Not elsewhere classified. [b]Not elsewhere specified.

HOW TO ATTRACT TENANTS

Some foreign trade zones such as the New York zone attract tenants naturally. With its large international trading community and major air and marine terminals, the New York zone has only to provide reasonably efficient management to ensure a high rate of use. For other zones, the task can be more difficult; major educational and incentive programs must often be initiated to attract tenants.

In some cases, foreign trade zones tend to have specialties. Unique characteristics and locational factors often make a zone attractive to certain industries or specific types of activity. For instance, Battle Creek, Michigan (zone 43), serves the surrounding pharmaceutical industry; Buffalo, New York (zone 23), takes advantage of its close proximity to Canada; and the South Carolina zones serve the textile industry.

There are various types of tenants or users that may have requirements for a foreign trade zone. Some will require only limited storage space in the zone and may have only a few transactions a year. Others may invest in equipment and fixtures in the zone and employ a large production and support staff. Still other tenants will seek subzones so that the advantages of a foreign trade zone can be transferred to their existing plant.

In seeking tenants, two factors should be considered: (a) the contribution of a tenant to the zone's overall goal of creating economic activity that would otherwise not have existed and (b) the contribution the tenant will make to the zone's fixed operating expense. For example, an international manufacturer may be seeking a new plant location and may consider the close proximity of a foreign trade zone to be an important factor. This manufacturer could be a valuable tenant because of the economic impact it could have on the community even though its initial contribution to

the zone's operating expenses may be minimal. On the other hand, it is obvious that a zone cannot survive on tenants that have only occasional storage and distribution requirements. At least one high-quality tenant is needed if the zone is to succeed financially. A high-quality tenant represents a permanent fixed enterprise that can make a substantial contribution to the zone's fixed operating expenses.

There is a chicken-and-egg relationship between the quality of the tenants that are attracted and the financial success of the zone. Although the grantee is discouraged by the board from showing a profit from the zone's operations, there must be adequate income to support capital improvements, utilities, staff, and promotional activities. The greater the number of high-quality tenants, the higher is the income available to improve facilities and conduct promotional activities. These expenditures, in turn, attract even more tenants.

A variety of steps can be taken to market a foreign trade zone and make it attractive to potential tenants. First, it is essential that the zone be well managed and free of political interference. Nothing is more discouraging to a businessman contemplating a long-term investment than the prospect that a change in the political winds will alter the conditions on which the investment decision has been based. This contributed to the failure and revocation of the grant for the Mobile, Alabama, zone.

In addition, the facilities should be clean and functional. Since a high-quality tenant may locate equipment and staff within the zone, the facilities should be equal to those the tenant would have chosen at a location outside the zone.

The grantee-operator should have a professional staff and, where appropriate, directors or governors with recent successful business experience. The staff should be oriented to providing service and should understand and be sympathetic to the profit motive of the tenants.

If a new zone grant has just been granted and the grantee is seeking its initial tenants, concentration should be placed on the firms providing the letters of intent as well as on any leads from the feasibility survey, both of which were a part of the application process. Individual visits to potential tenants by the zone staff are essential. If necessary, incentives, including state and/or city tax breaks, should be used to influence high-quality tenants.

The grantee-operator may find that it is necessary to conduct an extensive educational program. Many potential tenants are not aware of the possible uses of a foreign trade zone. One way to correct this problem is to sponsor seminars on the many advantages of foreign-trade-zone use. Another is to prepare an illustrated presentation that can be given to local business groups.

Perhaps the most effective means of locating and attracting tenants is through concentrated research and door-knocking by the zone representatives. For instance, meetings with banks, customs brokers, and cargo carriers will often result in ideas for trade zone applications and industry contacts. Research information on imports and exports to and from the economic hinterland of the foreign trade zone can be obtained from the New York Journal of Commerce and the U.S. Bureau of the Census. A sample of a recent census data run is given in Table 3. This information will prove useful in identifying potential zone users.

When grantee-operators do not have an adequate staff to conduct complete and ongoing tenant solicitation, there are a number of specialized consultants who can undertake the necessary work on behalf of the grantee.

HOW TO RETAIN TENANTS

Finally, it is important to retain tenants once they have occupied the zone, either with products in storage or with manipulation or manufacturing processes. Tenants, like customers everywhere, will stay where the service is good and the prices are reasonable. Some zones have complained that their tenants have been pirated or stolen by other competing zones, and as a result the zones have become very secretive about their tenants and their operation. This type of defensive activity only detracts from a zone's main concern, that of providing superior service. It is virtually impossible to pirate or steal tenants who are happy with the service they are receiving.

CONCLUSIONS

Foreign trade zones have a bright future in the coming decade and can serve as a real asset to river ports and their hinterlands. However, success in foreign-trade-zone operations is not automatic and is in fact a direct function of the number and quality of the tenants. Zones that achieve their goals of attracting new economic activity will be those that have understood the concept of service in attracting and sustaining their customers, the tenants.

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Financing Inland Port Development

JAMES H. KELLOW

The financing of future port facilities will require agressive marketing efforts as a basis for developing creative financing strategies. The various types of funding for inland port development—federal, state, regional, and local—are outlined. It is concluded that, because of the wide range of requirements for public funds and future prospects for a reduction in available resources at all levels, future inland port development will be largely in the hands of private entrepreneurs and that a sound, integrated public-private financial plan will be a necessity in the 1980s.

Many studies, including the recently completed Mid-America Ports Study (1), point to the significant benefits that accrue to local communities and private firms from port development as well as the future need for additional facilities on the inland waterways system (as referred to in the study, Mid-America consists of Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky,

Louisiana, Minnesota, Mississippi, Missouri, Nebraska, Ohio, Oklahoma, Pennsylvania, Texas, West Virginia, and Wisconsin). Projections in the study indicate that by the year 2000 cargo will exceed existing port capacity by almost 700 million tons annually.

The capital investment needed to accommodate the forecast growth is projected to be $9.5 billion. This money will provide more than 1000 new port terminals, on more than 100 miles of waterfront and 11 000 acres of land, plus additional acreage for industrial facilities that will be served by these terminals. This is the investment required for new port development and does not include funding for modernization to existing facilities.

Historically, ports on the inland waterways system of the United States developed and grew either because of the location of a major firm that built privately funded river shipping and related facilities or because a state or local community provided public shipping facilities as part of its industrial development program and encouraged firms to use them.

My own experience has convinced me that there is no one best way, no pat formula, that could be used by all communities to develop and finance a new port or expand an existing facility (2). On the contrary, basic developmental and financial considerations for the port planner are dictated by the local community's relationship to the regional and national transportation system, local competitive industrial location advantages, as well as local community, state, and private investor attitudes toward port development.

The attitudes and commitment of a local community toward port development will involve political, social, and economic considerations. Of course, the same may be said about state, regional, and federal funding sources. Private funding sources will certainly be conscientious about the political and social climate, but the private sector's investment decision is more economically oriented.

As we move into the 1980s, the trend is toward fiscal conservatism, and no single unit of government may be capable of financing port development. Rather, the successful port development or improvement project in the future will probably be the project that has a sound, integrated financial plan that includes limited public funds from a variety of sources to provide leverage for private investment.

This paper briefly discusses possible funding sources that a local port might consider in preparing an integrated financial plan.

LOCAL GOVERNMENT FUNDING

Local government funding for a port may take the form of revenue bonds for the acquisition and/or development of the facilities. Other potential local contributions may include the grant of funds or existing owned land or facilities, the annual payment of operating expenses, or a combination of such funding.

The usual reason for such commitment at the local level relates to providing additional local jobs and tax base. Therefore, the community attitude toward growth and industrial development, the existing financial condition, and the extent of need for other public expenditures by the local governmental unit will play a large part in the decision of the amount and type of local funding support made available for the port development. Because most local governments have more identified needs than financial capacity, the amount of financial aid they can provide to any one project is limited. In addition, the lack of an immediately identifiable benefit may affect local funding. In the case of the Louisville and Jefferson County Riverport Authority, we are fortunate that Jefferson County, Kentucky, has guaranteed the initial $6.5 million bond issue used to acquire the property for the port complex as well as annual operating expenses.

STATE GOVERNMENT SOURCES

Grants

To varying degrees, states have established agencies to help in developing their states' port potential (3). Some states have established centralized agencies that plan, finance, and operate local ports; others essentially provide a source of capital financing and, once the port has been established, are not involved in providing operating subsidy; others fund both capital and operating needs; and still others have limited, if any, real involvement. Space does not permit a detailed discussion of each state's activities, and so I have restricted my comments to the state of Kentucky (4).

Kentucky is committed to the development of river ports. As a part of that commitment, in 1966 the state created the Kentucky Port and River Development Commission to aid in the promotion and development of river-related industry, agriculture, and commerce in the state and to aid in the promotion and development of local port authorities. The commission consists of the Kentucky Commissioner of Commerce, the Secretary of the Cabinet for Development, and five citizens appointed by the Governor.

This commission is the main agency of Kentucky state government to which local Kentucky ports look for capital investment funding. Only funding for nonoperating purposes is provided. Based on the recommendation of the commission, funds are appropriated every two years by the state legislature and allocated by the commission to specific Kentucky port authorities.

To date, the commission has helped to establish local ports in Louisville, Paducah, Owensboro, Henderson, Eddyville, Hickman, Maysville, Ashland, and northern Kentucky. The largest of these is Louisville, with more than 1600 acres of property. Grants amounting to $17.5 million have been made to Kentucky ports. Louisville has received $1.6 million from the commission and has requested another $6 million during the next two years, in addition to state highway funds of $2.7 million. The philosophy of the Kentucky Port and River Development Commission is that the funds represent seed money to help obtain capital from other public and private sources. Total funding for a specific project is not contemplated.

Local participation in the project is particularly important in the commission's allocation decision. Grants to a local port are based on the justification submitted by the local port for capital expenditures and the project's economic impacts and benefits compared with those of other projects in the same location or different locations. No funding is provided to any port where economic feasibility has not been determined.

Although there are several state agencies in Kentucky that provide funds to assist local ports, requests for all such funds are channeled through the commission. This allows a consolidation of expenditures for ports in one state agency and also aids the local ports by reducing the coordination and red tape that are required. In addition to funding, technical assistance is also available from the commission's professional staff.

It should be mentioned at this point that, although the state of Kentucky and many other states heavily support the development of ports, present federal-state cost-sharing proposals being considered for locks and dams and other waterway improvement projects may restrict greatly the ability of states to provide continued heavy support for future local port development.

Loans

Loans can be obtained for port facilities through the Kentucky Development Finance Authority, an independent state agency. The agency's purpose is to promote and aid the development of industrial, manufacturing, commercial, and agricultural enterprises. It was established in 1958 and is controlled by a board of 14 members appointed by the Governor. Its funds are obtained from legislative appropriations and from borrowing from state employee pension funds. Qualifications for a loan are very similar to those for loans from private financial institutions. Loans are available to local development agencies, including ports, and to private firms on a participation basis.

Industrial revenue bonds have been permitted since 1950 in Kentucky. In addition to the Kentucky Development Finance Authority, any city, county, or local port authority is authorized to issue industrial revenue bonds.

Further state sources of specialized funding for private firms, other than that allocated by the legislature, are the Business Development Corporation of Kentucky, the Kentucky Highlands Investment Corporation, and Equal Opportunity Finance, Inc. In addition, the Kentucky Pollution Abatement Authority may issue bonds for a firm's pollution control facilities.

REGIONAL FINANCING PROGRAMS

There are funds available to local communities from regional sources such as the Appalachia Regional Commission and the Ozark Regional Commission. However, since the main sources of funds for such commissions are state and federal, the future level of such funds may be limited, and a direct allocation to a port from a state or federal source may provide a greater level of support. Nevertheless, if funds are available, they should be pursued.

FEDERAL FINANCING PROGRAMS

The principal source of federal funding for port development is the Economic Development Administration (EDA). Other federal agencies that have provided grants to ports include the Maritime Administration, the Office of Coastal Zone Managment, the U.S. Department of Transportation, the Law Enforcement Assistance Administration, the Sea Grant Program, the U.S. Department of Agriculture, the Farmers Home Administration, and the Environmental Protection Agency.

As we all know, competition for grant money is very keen. Therefore, the use of a skilled "grantsman" is almost mandatory. A grantsman helps to alleviate much of the frustration for port planners and to shorten the time between a request for funds and approval. Such skilled help has been provided by Jefferson County.

INTERNAL PORT FUNDING

A local port may use its own retained earnings or, where permitted legally, issue its own revenue bonds. These bonds may be backed either by a pledge of anticipated revenue by the port or a pledge of the use of port facilities by one or more private firms (5). Such bonds can be used to fund a wide range of facilities and can provide significant revenue for a port's growth and development at the time of actual demand for such growth.

Many currently programmed port projects are planning to use the latter funding method. In many cases, this is the safest method for the port in that the specific project must stand on its own. It also requires the least commitment from a public agency to pay off the debt.

Other possible funding methods that should be considered are lease and lease-purchase plans. Such plans might provide for a year-to-year, renewable lease with an option agreement that allows termination at the end of any given year should funds not be appropriated for the future year's lease payment. Ownership of the item may be assumed at the end of the full lease. Third-party financing should be considered when a facility is built by an operator or a subsidiary of the engineering firm that designed the facility. The third-party concept is particularly useful when there are several facility users, none of which has sufficient demand to justify the financing. In addition, local ports and communities may issue bonds backed by private firms to finance pollution control facilities.

SUMMARY AND CONCLUSIONS

From this brief discussion, it is obvious that, in Kentucky (and, in my opinion, in all states), if the economic justification for a port exists and a community wants it, the funding sources exist to help to make the port a reality. The real decisions facing the local community are in preparing its strategy for port development and financial marketing. In these decisions, such factors as the environment, the need for related public facilities such as roads and schools, the local labor force, the existing economic base, and the size and geographic location of the community must be considered. One of the most important decisions is the degree to which the development strategy will rely on public revenue versus private funding.

In light of the wide range of local requirements for public funds and the future prospects for reduced state, regional, and federal help, it is probable that future port capital development will be accomplished primarily with private funds or publicly issued bonds backed by leases or the credit of one or more private firms. Therefore, although the acquisition of water-oriented land and basic infrastructure development such as roads, water, and sewers will probably always require at least some public financing, the future development of inland ports appears to be largely in the hands of private entrepreneurs. We all know that competition for private development capital is very keen. The financing of future port facilities will thus be directly related to how successful we are in our marketing programs.

The strategy of the local port authorities of the future is likely to be that suggested in the Mid-America Ports Study: develop a master plan for the port complex and the adjacent waterfront and encourage the private sector to plan and construct facilities in accordance with the port master plan.

REFERENCES

1. Tippets-Abbett-McCarthy-Stratton. Mid-America Ports Study. U.S. Department of Commerce, Vol. 1, June 1979.

2. R.D. Dean and J.H. Kellow. Inland Harbor Development Strategies. American Industrial Development Council Journal, Vol. 8, No. 2, April 1973.
3. J.L. Hazard. The Public Role in Port Development. National Transportation Policy Study Commission, Washington, DC, Working Paper 3, Aug. 1979.
4. Financing Methods for Kentucky Business and Industry. Kentucky Department of Commerce, Frankfort, 1978.
5. L.K. Barba. Port Financing: Tax-Exempt Financing with Bond Issues. World Ports, Jan.-Feb. 1979.

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Economic Feasibility of Transporting Western Coal on the New York State Barge Canal System

JAMES E. VITALE

The results of a comparative economic study of the feasibility of transporting western coal to New York State utilities via the barge canal system are presented. Three coal-supply regions are delineated: southwestern Pennsylvania and northern West Virginia, Wyoming, and Montana. Site-specific projections of potential coal consumption developed for coal from each region are presented. A costing framework that includes all unit operations in the mine-to-stack coal-use cycle is used in making economic comparisons of the use of the three coals at new generating stations. This framework is designed to account for major expenditures that vary as a function of the characteristics of coal quality, including (a) extraction costs, (b) distribution costs, (c) flue-gas-desulfurization system investment and operating costs, and (d) balance-of-plant investment expenditures. The methodology is applied to a comparison of the economics of using the three coals at a future mid-Mohawk River Valley generating facility.

In recent years, commercial traffic on the New York State barge canal system has steadily decreased. To ascertain the causes of this decline and estimate future traffic volumes, the New York State Department of Transportation engaged Roger Creighton Associates, Inc., to conduct a market study of the canal system. Cargo potentials and transportation cost savings resulting from the use of the canal were estimated for two situations: (a) continued operation of the existing facilities and (b) operation of an improved and modernized canal that could accommodate larger barges and tows.

A major component of the market study was an assessment of the economic feasibility of transporting western coal to New York State utilities via the canal system. It was felt that emerging federal policies on energy resources and environmental quality might create pressures for increased use of western coal in the state. This potential demand for western coal, coupled with the construction of a proposed transshipment facility at the Port of Buffalo, might in turn lead to significantly increased traffic on the canal system. Thus, western coal was considered to be the bulk commodity that had the greatest potential for large-volume, long-term shipment via the canal.

The primary purpose of this paper is to report and update the coal-related portion of the market study. It also serves to illustrate the importance of using a total systems approach in estimating future levels of coal traffic on waterways and rail lines and through ports.

GENERAL METHODOLOGY

A comparative economics approach was used in the study to assess the feasibility of transporting western coal to New York State utilities via the canal system. This methodology consisted of four major components, each of which is discussed in this paper:

1. Three coal-supply regions were delineated: southwestern Pennsylvania and northern West Virginia (coal A), northern Wyoming (coal B), and Montana (coal C). There are major differences in physical characteristics and free-on-board (FOB) mine prices for coals produced in these regions. Moreover, northeastern utilities either use or have considered using coal produced in these areas.
2. Site-specific projections of potential coal consumption (for coal from each region) were developed. These estimates were derived from the announced plans of New York State utilities (1) and interviews with personnel of the New York State Public Service Commission.
3. A costing framework that included all unit operations in the mine-to-stack coal-use cycle was developed and quantified. Since this analytic construct was to be used to compare the economics of using alternative coals at new generating stations, it was designed to account for all major expenditures that vary as a function of coal quality.
4. This framework was applied to all potential supply-demand pairs, and estimates of future western coal traffic on the canal system were made. Rational economic behavior on the part of potential coal consumers was assumed; that is, it was assumed that the source of coal supply and the transportation mode or route configuration for which total annual costs would be lowest would always be chosen.

COAL-SUPPLY REGIONS

For the purposes of this inquiry, one eastern and two western coal-supply regions were delineated. It was assumed that eastern coal would originate from mines located in southwestern Pennsylvania and northern West Virginia, a region that has large quantities of untapped reserves and excellent access to New York State markets via the existing rail system.

The boundary between the states of Wyoming and Montana was used to divide the Powder River Basin into two supply regions. This strategy was dictated by differences in quality characteristics and FOB mine prices of coals produced in these states as well as differences in the accessibility of these

regions to eastern markets via major transportation corridors.

The physical characteristics of the coals used in this study are given in Table 1 (2). It should be noted that characteristics such as heat and sulfur content vary both within and between coal seams. Thus, the information given in Table 1 is considered to be "typical".

POTENTIAL DEMAND FOR WESTERN COAL

For the purposes of this study, I have focused exclusively on the use of western coal as a fuel to fire new steam electric generating stations. It has been assumed that all plants in the state that currently burn eastern coal will continue to do so. It has also been hypothesized that generating stations that might reconvert from oil to coal would fire eastern coal. Use of western coal at such facilities could require extensive expenditures for boiler modifications, rehabilitation or expansion of coal-handling equipment, and acquisition of new (or enlarged) storage areas. Moreover, use of western coal at stations originally designed to burn eastern coal would result in a substantial reduction in the generating capacities of the plants.

It has been assumed that five new coal-fired power plants with a combined capacity of 6650 MW will come on-line before the year 2000. The locations, gross generating capacities, and target service dates of these facilities are given in Table 2. All information given on the three known stations reflects the expansion plans of member utilities of the New York Power Pool for the next 15 years. Interviews with New York State Public Service Commission personnel revealed that two additional 1700-MW coal-fired stations--a Lake Ontario plant northeast of Oswego and a facility in the mid-Mohawk River Valley--might be constructed before the year 2000. It was optimistically assumed that this additional base-load capacity would come on-line in accordance with the schedule given in Table 2.

Table 1. Average characteristics of coals A, B, and C.

Source	Designation	Heat Content (Btu 000s) Per Pound	Per Ton	Sulfur Content Percentage by Weight	Pounds per Million Btu
Pennsylvania and West Virginia	A	12	24 000	2.3	3.83
Powder River Basin					
Wyoming	B	8.3	16 600	0.5	1.2
Montana	C	8.8	17 600	0.85	1.93

Site-specific and total estimates of potential coal demand are given in Table 3. Two points regarding these projections are worthy of note. The first is that the volume of coal required to generate 1 kW•h of electricity is a function of (among other factors) coal heat content. I have therefore reported three different estimates of potential coal demand by assuming the use of coal produced in the supply regions described above. The second point is that all site-specific coal requirements have been derived from the demand forecasts developed for the Niagara Mohawk Power Corporation's proposed Lake Erie Generating Station (2). Here it is assumed, in effect, that the heat rates (heat input required to generate 1 kW•h of electricity) and capacity factors (proportion of time that a unit is on-line) of all facilities given in Table 3 will be identical to those for the Lake Erie station. The impact of these assumed parameter values on potential annual demand for the three candidate coals studied is illustrated by the data given in Table 4.

ANALYTIC FRAMEWORK

A sequential, integrated construct was used to assess the feasibility of transporting western coal to New York State utilities by way of the canal system. Since this framework was developed for the purpose of comparing the total economics of using alternative coals at new generating stations, it was designed to account for major expenditures that vary as a function of the characteristics of coal quality, including (a) extraction costs, (b) distribution costs, (c) flue-gas-desulfurization (FGD) system investment and operating costs, and (d) balance-of-plant (BOP) investment expenditures (for equipment such as boilers and coal-handling and storage facilities).

It should be noted that, whenever possible, procedures and cost estimates developed by personnel of the Public Service Commission and utility industry consultants were used in an attempt to render the analyses as realistic and meaningful as possible.

Extraction Costs

The FOB mine prices used in the study are given in Table 5 (2). It was assumed that Appalachian coal would originate from large underground mines in which continuous mining equipment and the room-and-pillar mining plan are used. All Powder River Basin coal was assumed to originate at large surface mines.

As Table 5 indicates, two FOB mine prices for Appalachian coal were used in all analyses. This strategy was dictated by a lack of consensus among coal producers as to the most appropriate contract

Table 2. Projected additions to generating capacity.

Location	Facility	Operating Company	Capacity (MW)	Target Service Date
Pomfret	Lake Erie Generating Station (LEGS)	NMPC	1700 (two units at 850 MW each)	Unit 1, 1988; unit 2, mid-1989[a]
Niagara County	Somerset	NYSEG	850	November 1983[a]
Arthur Kill	700 Fossil	PASNY	700	November 1984[a]
Lake Ontario northeast of Oswego[b]	—	Unknown	1700 (two units at 850 MW each)[c]	Unit 1, 1993; unit 2, mid-1995
Canajoharie (mid-Mohawk River Valley)[d]	—	Unknown	1700 (two units at 850 MW each)[c]	Unit 1, 1996; unit 2, 1998

Note: NMPC = Niagara Mohawk Power Commission; NYSEG = New York State Electric and Gas; PASNY = Power Authority of New York State.

[a] New York Power Pool Planning Committee (1, p. 318).
[b] Use of this site suggested by Weber of the New York State Public Service Commission during an interview conducted on April 12, 1978.
[c] Declared the most probable configuration for new coal-fired plants by Swanson of the New York State Public Service Commission during a March 3, 1978, meeting.
[d] Use of this site suggested by Swanson, Hausgaard, and Cummings of the New York State Public Service Commission during a March 3, 1978, meeting.

Table 3. Potential annual coal demand.

Location	Facility	Unit No.	Potential Annual Demand (tons) Coal A	Coal B	Coal C
Niagara County	Somerset	1	1 861 083	2 834 518	2 637 784
Arthur Kill	700 Fossil	1	1 532 602	2 334 226	2 172 715
Pomfret	LEGS	1	1 861 083	2 834 518	2 637 784
		2	1 861 083	2 834 518	2 637 784
Sackets Harbor	–	1	1 861 083	2 834 518	2 637 784
		2	1 861 083	2 834 518	2 637 784
Canajoharie	–	1	1 861 083	2 834 518	2 637 784
		2	1 861 083	2 834 518	2 637 784
Total			14 560 183	22 175 852	20 636 703

Table 4. Operating parameters for one Lake Erie Generating Station 850-MW coal-fired unit.

Parameter	Coal A	B	C
Coal heat content (Btu/ton)	24 000 000	16 600 000	17 600 000
Net station heat rate (Btu/kW·h)	9410	9795	9770
Net unit capability (kW)	785 350	794 800	786 200
Differential capability (kW)	9450	Base	8600
Average annual capacity factor (%)	69	69	69
Time in operation (h/year)	6044	6044	6044
Annual burn[a] (Btu x 10^{12})	44.666	47.053	46.425
Annual coal consumption[b] (tons)	1 861 083	2 834 518	2 637 784

[a]Net station heat rate X net unit capability X time in operation.
[b]Annual burn ÷ coal heat content.

Table 5. Extraction costs for coals A, B, and C.

Coal	Type of Mine	Quotation	Production Costs ($/ton)
A	New underground shaft or slope	Avg from several producers or sales agents	24.76[a]
		Consolidation Coal Company	29.52[a]
B	Surface		7.50[b,c]
C	Surface		9.00[b,d]

Note: Costs are in 1977 dollars.
[a]Deescalated from 1978 FOB mine prices provided by the staff of Coal Week.
[b]Figures that have been used by the New York State Public Service Commission.
[c]Includes 17 percent Wyoming severance tax.
[d]Includes 30 percent Montana severance tax.

price for a 12 000-Btu/lb, 2.3 percent sulfur coal produced at a new underground mine in that region. An informal telephone survey of coal producers and sales agents was conducted by the staff of Coal Week. This survey revealed that Consolidation Coal Company would supply a coal that complies with the above specifications for $31/ton whereas the average FOB mine price quoted by all other parties interviewed was $26/ton. In the opinion of Coal Week staff, Consolidation Coal Company is able to obtain a higher price for the same product because the large sales volume of the company's operations in the region enables it to provide unusually reliable service to consumers.

Distribution Costs

It was assumed that western coal destined for New York State would be loaded into unit trains at the mines in Montana and Wyoming and transported (via the Burlington Northern) to the Midwest Energy Terminal at Superior, Wisconsin. At that point, the coal would be unloaded, stored, and loaded into specially constructed, self-unloading vessels (with capacities of 67 000 tons) for delivery to either a lake-site plant or a proposed bulk commodity terminal at the Port of Buffalo. (Use of the proposed transshipment facility for movements to lake-site plants has also been analyzed on a case-by-case basis. It has been assumed that consumers always opt for the least-cost mode or route configuration.) Coal destined for inland plants would then be loaded into hopper cars or barges for final delivery via rail or the canal system.

It has been assumed that all western coal destined for inland plants passes through the proposed Buffalo transshipment facility. Thus, all such consumers face identical FOB Buffalo prices for Montana and Wyoming coals. The unit costs included in these prices (2) are given below (the rail rate is for unit train shipments from mine to midwest energy terminal; rail car costs are amortized, assuming 10 000-ton unit trains and a five-day round-trip time):

Item	Coal B (Wyoming)	Coal C (Montana)
Cost per ton ($)		
FOB mine	7.50	9.00
Rail		
Rate	9.75	7.00
Car costs	1.50	1.50
Transshipment at midwest energy terminal	1.50	1.50
Great Lakes vessel to Buffalo	4.10	4.10
Transshipment at Buffalo	1.15	1.15
Total	25.50	24.25
Total cost per million Btu ($)	1.54	1.38

As noted above, it was assumed that western coal is transported from Buffalo to New York State utilities by either the rail mode or the canal system, depending on relative modal costs (shipments are always assigned to the least-cost mode or route configuration). It was further assumed that all eastern coal would originate at Pittsburgh and be transported directly to the consumption sites. Since rail rates for coal shipments between most of the origin-destination pairs analyzed do not exist, the following strategy was used.

Unless otherwise noted, all estimates of unit train rates were derived from a regression equation that expresses rates (in dollars per ton) as a function of length of haul. Data from the New York State Public Service Commission on existing rates for 13-unit train shipments from Pennsylvania and West Virginia mines to New York State generating stations were used to calibrate this equation (all rates were applicable to shipments of bituminous steam coal, effective as of November 30, 1977). Since short-line rail distances were not reported, they were estimated from 1976 state transportation maps of New York, Pennsylvania, and West Virginia, which were prepared by the U.S. Geological Survey.

The calibrated relationship is

$$U = 3.771 + 0.0122X \quad R^2 = 0.61 \qquad (1)$$

where

U = unit train rate ($/ton),
X = length of haul (miles), and
R^2 = proportion of variation in rates accounted for by distance.

Table 6. FGD system efficiencies that comply with original and revised NSPS.

NSPS	Maximum Allowable SO_2 Emissions (lb/million Btu)	Coal A		Coal B		Coal C	
		Uncontrolled SO_2 Emissions (lb/million Btu)	Removal Required (%)	Uncontrolled SO_2 Emissions (lb/million Btu)	Removal Required (%)	Uncontrolled SO_2 Emissions (lb/million Btu)	Removal Required (%)
1971	1.2	3.83	69	1.2	0	1.932	38
1979	≤0.6	3.83	84	1.2	50	1.932	69

Note: All removal requirements are computed for a 30-day averaging period.

Table 7. Investment requirements for FGD systems for two 850-MW units.

Item	Coal A		Coal B		Coal C	
	Original NSPS	Revised NSPS	Original NSPS	Revised NSPS	Original NSPS	Revised NSPS
Total direct construction cost ($)	202 876	209 151	0	194 833	176 821	206 046
Indirect cost, contingencies, and fees ($)	52 233	53 849	0	50 167	45 524	52 954
Total construction cost ($)	255 109	263 000	0	245 000	222 345	259 000
Net generating capacity (kW)	1 570 700	1 570 700	1 589 600	1 589 600	1 572 400	1 572 400
Cost of net capacity ($/kW)	162	167	0	154	141	165

Note: Figures are in 1985 dollars.

Table 8. Annual FGD system operating costs for two 850-MW units.

Coal	NSPS	SO_2 Removal Requirement (%)	Annual FGD System Operating Costs[a] ($000s)
A	Original	69	20 542
	Revised	84	23 530
B	Original	0	0
	Revised	50	10 936
C	Original	38	13 806
	Revised	69	17 267

Note: Costs are in 1985 dollars.

[a]Includes annual costs for limestone, lime additive, waste disposal operating costs, and annual capability charge.

Transportation costs for shipment via the canal system were estimated for two scenarios: (a) continued operation of existing facilities and (b) operation of an improved and modernized canal. Currently, lock chambers on the canal constrain vessel and tow size to a maximum width of 43.5 ft and a maximum length of 300 ft. Effective drafts are 13 ft on the Oswego Canal and the Erie Canal west of Three Rivers, New York, and 11 ft on the remainder of the system. In the second scenario, which assumed a canal system expanded and modernized to handle specially constructed, self-unloading barges, lock chambers were assumed to be 1000 ft long and 110 ft wide and to have a depth over sill of 27 ft.

Distribution costs were estimated for each scenario. Individual components included in those cost estimates were variable and fixed operating costs, profits, transit times, locking and terminal times, and inventory costs.

An in-depth discussion of the method used to estimate costs for transportation via the canal system is given elsewhere (3).

Flue-Gas-Desulfurization Costs

It has been assumed that all generating stations included in this analysis will use limestone FGD systems. Capital and operating costs for such systems depend on several factors, including the maximum allowable rate of sulfur dioxide (SO_2) emissions, the sulfur content and heating value of the coal, boiler size and capacity, boiler status (new or retrofit), and replacement power requirements (4). The complex manner in which many of these factors interact, and thus affect costs, dictated the use of generic cost estimates. However, to assess the impacts of recently promulgated environmental standards on the costs resulting from the use of eastern and western coal, estimates were developed for two sets of SO_2 emission limitations.

The Clean Air Act Amendments of 1970 required the U.S. Environmental Protection Agency (EPA) to develop primary and secondary national ambient air quality standards for sulfur dioxide (although emission limitations for particulates and nitrogen oxide were also established, sulfur dioxide regulations have had the greatest impact on coal production and distribution patterns). In December 1971, EPA responded to that mandate by establishing New Source Performance Standards (NSPS), which limited emissions from new electric generating stations to 1.2 lb SO_2/million Btu of heat input.

It is important to note that utilities could comply with those regulations by either (a) direct combustion of low-sulfur (primarily western) coals or (b) use of high-sulfur coals in conjunction with FGD systems. The actions of many major utilities indicate that use of low-sulfur western coal was considered to be the most economical and technologically workable alternative. The attractiveness of this compliance strategy is demonstrated by the fact that in 1976 more than 11 million tons of western coal were consumed in Illinois, a state endowed with large quantities of high-sulfur coal reserves (5).

In accordance with the Clean Air Act Amendments of 1977, EPA issued modified NSPS in June 1979. These revised standards require all new coal-fired power plants to install and continuously operate FGD systems, regardless of coal sulfur content. Thus, as a direct result of these regulations, the cost associated with use of western coal will increase.

Statistics on requirements for the removal of sulfur dioxide for the coal-supply options considered in this analysis are given in Table 6 for the 1971 and 1979 NSPS. As the data given in that table indicate, direct combustion of the Wyoming coal would have been permissible under the provisions of the 1971 standards. The revised NSPS allow use of this coal only if scrubbers are installed and one-half of the uncontrolled SO_2 emissions are re-

Table 9. BOP order-of-magnitude investment costs.

Item	Cost ($000s)								
	Coal A			Coal B			Coal C		
	Unit 1	Unit 2	Total	Unit 1	Unit 2	Total	Unit 1	Unit 2	Total
Direct construction costs	188 077[a]	148 660	336 737	225 503[b]	171 784	397 287	225 503[b]	171 784	397 287
Indirect construction cost, contingencies, and fees (28 percent of direct)	52 662	41 625	94 287	63 142	48 100	111 242	63 141	48 100	111 242
Total	240 739	190 285	431 024	288 644	219 884	508 529	288 645	219 884	508 529

Note: Costs are in 1985 dollars.

[a] Does not include cooling-tower make-up (intake) and blow-down (discharge) lines or coal-receiving equipment.
[b] Does not include cooling-tower make-up and blow-down lines or coal-unloading facility and tunnel.

Table 10. Fuel-supply analysis for an inland facility.

Item	Coal A		Coal B			Coal C		
	Min	Max	Canal 1[a]	Canal 2[b]	Rail	Canal 1[a]	Canal 2[b]	Rail
FOB mine ($/ton)	24.76	29.52	7.50	7.50	7.50	9.00	9.00	9.00
FOB terminating mode at Buffalo[c] ($/ton)	NA	NA	25.50	25.50	25.50	24.25	24.25	24.25
Rail rate to destination ($/ton)	9.44	9.44	NA	NA	6.43	NA	NA	6.43
Canal charges from Buffalo to site[d] ($/ton)	NA	NA	8.46	1.67	NA	8.46	1.67	NA
Total ($/ton)	34.20	38.96	33.96	27.17	31.93	32.71	25.92	30.68
Total ($/million Btu)	1.43	1.62	2.05	1.64	1.92	1.86	1.47	1.74

Note: Analysis for Canajoharie location as described in Table 2.

[a] Existing canal dimensions (costs for unloading at plant are assumed to be $1.50/ton).
[b] Entire canal system reconstructed to accommodate self-unloading vessel 1000 ft long and 110 ft wide with 27-ft drafts.
[c] For coals B and C, includes FOB mine price.
[d] Includes unloading costs.

moved from all flue gases.

The generic capital cost estimates used in this study for installation of FGD waste stabilization and disposal systems, assuming use of coals A, B, and C at a 1700-MW generating station, are given in Table 7 (2) for the original and revised NSPS.

The study performed by Ebasco Services, Inc. (2), was also used as the basis for estimates of FGD system operating costs. Supplemental data on the impacts of alternative SO_2 removal requirements on annual operating costs were provided by Weber of the New York State Public Service Commission. Table 8 gives generic estimates of FGD system annual operating costs for two 850-MW units.

Balance-of-Plant Investment Costs

BOP comparative investment costs include expenditures for major items that are dependent on the quality characteristics of a particular coal. Such items include steam generators, electrostatic precipitators, and all requisite concrete, structural steel, and electrical equipment.

All BOP cost estimates used here are, again, derived from work performed by Ebasco Services, Inc. (2). Table 9 gives these comparative investment costs for two 850-MW units. Expenditures for items common to both units are assessed to unit 1.

Illustrative Application

To facilitate the reader's comprehension of the methodology used in this study, the procedures have been applied to assessing the comparative economics of coals A, B, and C at the proposed mid-Mohawk River Valley generating facility. Three points about this illustrative application are worthy of note:

1. FGD system investment and operating cost estimates have been computed for SO_2 removal efficiencies that would have been required to comply with the 1971 NSPS.

2. The following escalation and amortization parameters were used in all calculations:

Parameter	Amount
Annual fixed capital charge rate (%)	18
Discount rate (%)	11.5
Escalation rate (%)	
Fuel (per year)	5
Materials	6
Labor	8
Operations and Management	5
Plant life (years)	30

Escalation rates for materials, labor, and operations and management are from Ebasco Services, Inc. (2). The other parameters given above are recommended by the New York State Public Service Commission.

3. To provide insight on the impacts of eastern coal prices on overall comparative economics, the two FOB mine prices for this fuel given in Table 4 were included in the analyses.

Computations of total delivered prices for the three types of coal at the mid-Mohawk River Valley location are given in Table 10. It was assumed that western coal destined for this inland plant would pass through the proposed Buffalo transshipment facility. Transportation costs were estimated by assuming shipment from Buffalo to the plant via the existing canal, an expanded and modernized canal, and unit trains. Eastern coal was assumed to be shipped directly from mines to the consumption site in unit trains.

It is of interest to note the effects that coal heat contents have on total delivered prices (Table 10). Assuming massive reconstruction of the canal system, the delivered price of eastern coal (with an

Table 11. Fuel charges for unit 1, proposed Canajoharie facility.

No.	Item	Coal A Min	Coal A Max[a]	Coal B	Coal C
Annual Fuel Charge					
1	Fuel escalation rate (%/year)	5	5	5	5
2	Fuel cost as of operation date ($/million Btu)	3.61	4.09	4.14	3.71
3	Levelized fuel cost ($/million Btu)	5.66	6.41	6.49	5.81
4	Net generating capacity (kW)	785 350	785 350	794 800	786 200
5	Net station heat rate (Btu/kW·h)	9410	9410	9795	9770
6	Average operating time (h/year)	6044	6044	6044	6044
7	Annual burn (Btu × 10^{12})	44.666	44.666	47.053	46.425
8	Levelized annual fuel charge (no. 3 × no. 7) ($000s)	252 810	286 309	305 374	269 729
Energy Charge for Equivalent Generation					
9	Differential capability (kW)	9450	9450	Base	8600
10	Average charge (no. 3 × no. 5 × no. 6) ($/kW-year)	322	365	Base	343
11	Energy charge (no. 9 × no. 10) ($000s)	3043	3449	0	2950
12	Total annual fuel charge for this unit (no. 8 + no. 11) ($000s)	255 853	289 758	305 374	272 679

[a]Sensitivity alternatives.

Table 12. Fuel charges for unit 2, proposed Canajoharie facility.

No.	Item	Coal A Min	Coal A Max[a]	Coal B	Coal C
Annual Fuel Charge					
1	Fuel escalation rate (%/year)	5	5	5	5
2	Fuel cost as of operation date ($/million Btu)	3.98	4.51	4.57	4.10
3	Levelized fuel cost ($/million Btu)	6.24	7.07	7.16	6.42
4	Net generating capacity (kW)	785 350	785 350	794 800	786 200
5	Net station heat rate (Btu/kW·h)	9410	9410	9795	9770
6	Average operating time (h/year)	6044	6044	6044	6044
7	Annual burn (Btu × 10^{12})	44.666	44.666	47.053	46.425
8	Levelized annual fuel charge (no. 3 × no. 7) ($000s)	278 716	315 789	336 899	298 049
Energy Charge for Equivalent Generation					
9	Differential capability (kW)	9450	9450	Base	8600
10	Average charge (no. 3 × no. 5 × no. 6) ($/kW-year)	355	402	Base	379
11	Energy charge (no. 9 × no. 10) ($000s)	3355	3799	0	3259
12	Total annual fuel charge for this unit (no. 8 + no. 11) ($000s)	282 071	319 588	336 899	301 308
13	Total 1996 annual fuel charge for this unit ($000s)	255 847	289 876	305 577	273 295
14	Total annual fuel charge for all units ($000s)	511 700	579 634	610 951	545 974

[a]Sensitivity alternatives.

Table 13. Investment cost summary for Canajoharie facility under 1971 NSPS.

No.	Item	Cost ($000s) Coal A	Coal B	Coal C
1	BOP construction costs	818 219	965 341	965 341
2	Coal-receiving equipment and cooling-tower make-up and blow-down lines	17 085	7 593	7 593
3	Indirect costs, contingencies, and fees for no. 2	4 784	2 126	2 126
4	Total BOP comparative investment costs	840 088	975 060	975 060
5	FGD system	484 274	0	422 078
6	Total comparative investment costs (no. 4 + no. 5)	1 324 362	975 060	1 397 138
7	Annual capital charge (no. 6 × 0.181)	239 709	176 486	252 882

Note: Costs in 1996 dollars.

Table 14. Comparative economics for Canajoharie facility under 1971 NSPS.

Item	Amount ($000s) Coal A Min	Coal A Max	Coal B	Coal C
Annual capital charge	239 709	239 709	176 486	252 882
Annual fuel charges	511 700	579 634	610 951	545 974
Annual operating charges	35 134	35 134	0	23 613
Annual revenue requirements	786 543	854 477	787 437	822 469

Note: Figures are in 1996 dollars.

FOB mine price of $24.76/ton) is approximately $8/ton higher than that of Montana coal. However, when the heating values of the coals are used to convert these delivered prices to equivalent prices per million Btu, eastern coal enjoys a slight cost advantage. Thus, dollar-per-ton cost comparisons of

Table 15. Summary of site-specific annual revenue requirements.

Plant and Location	Operating Company	Status	Target Service Date	NSPS	Revenue Requirements ($000s) Coal A Min	Coal A Max	Coal B	Coal C
Somerset	NYSEG	Proposed	11/83	Old	203 320	223 219	214 693	221 183
				Revised	204 109	224 008	238 203	225 121
700 Fossil, Arthur Kill	PASNY	Proposed	11/84	Old	183 714	200 135	196 478	203 496
				Revised	185 859	202 280	217 753	207 581
LEGS, Pomfret	NMPC	Proposed	1/88	Old	505 155	552 271	503 542	528 073
				Revised	508 882	555 957	564 263	538 418
Sackets Harbor, Lake Ontario		Potential	1/93	Old	679 434	742 242	697 904	730 899
				Revised	684 283	747 091	778 378	749 018
Canajoharie		Potential	1/96	Old	786 543	854 477	787 437	822 469
				Revised	794 365	860 166	882 743	838 489

coals with different heat contents can be quite misleading.

Tables 11 and 12 give the annual fuel-charge computations for units 1 and 2 of the proposed generating station. Only the delivered prices of western coals that assume shipment via the minimum-cost mode and route configurations are subjected to further analysis.

As data given in Table 11 show, 1977 delivered prices (in dollars per million Btu) are converted to corresponding 1996 prices (the target service date for unit 1) by assuming an escalation rate of 5 percent/year. The resultant figures are then levelized to account for the present worth of price increases (at a rate of 5 percent/year) over the 30-year plant life (all fuel supply analyses conducted by New York State utilities use levelized fuel cost estimates). The levelization factor (LF) was calculated from the following formula:

$$LF = \{[1/(i - r)] \exp[(i - r)n] - 1\}/[-(i/r) \exp(-rn) - 1] \quad (2)$$

where

i = escalation rate (5 percent),
r = discount rate (11.5 percent), and
n = plant life (30 years).

Levelized fuel costs are determined by multiplying fuel costs (in dollars per million Btu) by the levelization factor. These costs are then multiplied by the projected annual burn (the product of net generating capacity, net station heat rate, and operating time) to obtain estimates of levelized annual fuel charges. Total annual fuel costs are equal to levelized annual fuel costs plus energy charges for differences in net generating capacities. The method used to compute energy penalties is presented in Table 11.

Total annual fuel charges for unit 2 are calculated in an analogous manner. Those costs are then converted to equivalent 1996 dollars and added to unit 1 charges to obtain total annual fuel charges for the plant (Table 12).

A summary of required investment expenditures for the proposed generating station is given in Table 13. These investment costs are amortized and added to annual fuel charges to determine the estimated revenue requirements given in Table 14.

Examination of that table reveals that the comparative economics of eastern and western coal at this hypothetical generating station are extremely sensitive to assumptions regarding the FOB mine prices of eastern coal. Use of the lower price ($24.76/ton in 1977 dollars) yields results that suggest that eastern coal would be the preferred fuel-supply option. If, however, comparisons are based on the higher price ($29.52/ton), the eastern coal alternative would be the most costly.

RESULTS AND CONCLUSIONS

Table 15 summarizes the comparative economics of eastern, Wyoming, and Montana coals at the five proposed New York State generating stations. Several points regarding the information displayed in Table 15 warrant discussion.

It should be noted that annual revenue requirements for the Montana and Wyoming (B and C) coal options were estimated by assuming the existence of a transshipment facility at the Port of Buffalo and an expanded and modernized canal system. (The locations of the Lake Erie Generating Station and the Somerset facility rendered shipment via the canal infeasible. In addition, direct delivery of western coal to the Lake Erie Generating Station was less costly than shipment through the Port of Buffalo.) In the absence of such facilities, delivered prices (and consequently annual revenue requirements) would be significantly higher.

Table 15 provides insight into the effects of the 1979 NSPS on the competitive position of western coals in New York State. As the table shows, the increases in total annual costs attributable to those standards are substantial, particularly for the Wyoming coal option.

The impacts of the assumed FOB mine prices for eastern coal on the costs related to its use at new coal-fired plants are significant. I am of the opinion that the annual revenue requirements based on the lower estimate ($24.76/ton in 1977 dollars) most accurately reflect prevailing coal market conditions. According to Coal Week, as recently as October 1979, 12 800-Btu/lb, 2.5 percent sulfur coal produced in southwestern Pennsylvania could be purchased under long-term contract for $27.00/ton FOB mine. When escalated (at 5 percent/year) to 1979, the minimum FOB mine price is $27.30/ton.

A comparison of the revenue requirements for coals A (minimum), B, and C in Table 15 for the revised NSPS scenario reveals that eastern coal is the preferred fuel supply option for all of the proposed generating stations. Thus, no large-volume shipments of western coal can be expected to traverse the canal system, even if it is modernized to deep-draft standards.

REFERENCES

1. Report of the Member Electric Systems of the New York Power Pool and the Empire State Electric Energy Research Corporation. New York Power

Pool Planning Committee, Guilderland, NY, April 1, 1978.
2. Niagara Mohawk Power Corporation Lake Erie Generating Station Fuel Supply Study. Ebasco Services, Inc., New York, July 1977.
3. Barge Canal Marketing Study: Technical Report. Roger Creighton Associates, Delmar, NY, Jan. 1979, Chapter 2, Section B.
4. Particulate and Sulfur Dioxide Emission Control Costs for Large Coal-Fired Boilers. PEDCo Environmental, Inc., Cincinnati, April 1978, pp. 2-4 and 2-5.
5. G.C. Krohm and C.D. Dux. The Price and Availability of Low-Sulfur Coal in Eastern Markets. Argonne National Laboratories, Argonne, IL, Rept. ANL/AA-12, July 1977.

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Foreign Trade Zones and Inland Ports: A Question of Size

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Although all domestic ports of entry are "entitled" to establish foreign trade zones under federal law upon meeting certain technical and economic requirements, the volume of international trade at inland ports is often marginal in terms of the need for zone services. Since many of these communities wish to use zones as a means of helping to attract new international-trade-related operations, their zone projects are often conceived for a small amount of activity at the outset and with an uncertain medium- and long-term outlook. The requirements of federal law and how they have been interpreted with regard to smaller zone projects are discussed. Recent interpretations and practices of the Foreign-Trade Zones Board and the U.S. Customs Service are discussed in terms of how they affect the feasibility of zones in inland areas that have an inherently smaller "zone-use base". A general analysis is presented of the first few inland zones. Some methods of structuring smaller zones to reduce and spread capital and operating costs are suggested. It is concluded that, whereas current federal procedures and practices make it possible even for smaller inland ports of entry to use zones in their economic development efforts, such communities should be mindful of the financial risks involved.

Although foreign trade zones have constituted a chapter in U.S. customs laws for some 45 years, it has not been until the past decade that they have become widely available in the United States. Congress coined the term "foreign trade zone" when the law that authorized these facilities--the Foreign Trade Zones Act--was enacted in 1934. In this paper, the term is used interchangeably with the general terms "free trade zone" and "customs-free zone". All are limited versions of the historic "free port".

Before 1970, fewer than 10 U.S. cities had foreign trade zones, all of them ocean or Great Lakes ports. By the end of the decade the number had increased to 50, and several of the new projects were bringing this international trade service to U.S. inland ports of entry for the first time.

Although the inland ports have always been eligible as sites for foreign trade zones, only recently have the agencies concerned with economic development in these areas taken an interest in making zones a part of their public services. The traditional association of customs-free zones with seaports, and major seaports at that, has undoubtedly been a psychological factor. Were it not for the provision in the U.S. Constitution that prohibits legislation favoring the ports of one state over those of another, the Foreign Trade Zones Act might well have perpetuated this stereotype. The fact that Congress did not find this narrower view appropriate and made all U.S. ports of entry eligible for zones gave the concept wider currency in the United States (there are more than 300 customs ports of entry in the United States, about 25 percent of which are involved with commercial shipments). This provided the legal foundation for the present growth in the U.S. zone program.

The spread of zones to inland U.S. ports has not been just a matter of overcoming a mental block. The very definition of a port has broadened in a dramatically changing world economy. International trade, direct investment, and transportation technology are weaving a new trade network. Most of the world's larger seaports retain their prominence but, throughout the network, inland centers of trade are growing and new ones are emerging. These communities, although smaller in size, are taking on the trappings of true port cities.

The products of modern technology are also affecting the role of inland ports. Multinational firms that produce and market these products have an unparalleled range of choices in the siting of plants and distribution centers. Industries are no longer as tied to certain locations as they once were. Mobility and flexibility are the rule. This places new and complex demands on port communities, including inland ports, which have become increasingly sensitive to the need for improved public services and facilities (1,2).

U.S. ZONES FROM 1934 TO 1970

The first U.S. foreign trade zones were, as expected, established as seaports. Through the late 1940s, New York, Mobile, New Orleans, San Francisco, Los Angeles, and Seattle were the only U.S. cities that were authorized zones. New York's zone was sponsored by the city government, which contracted the operation of its facility to a private firm. The other zones were from the outset owned and operated by seaport authorities, some of whom eventually took on private firms as zone operators. Both Los Angeles and Mobile closed their zones after a short time, apparently finding that customs-bonded facilities served their needs.

Even after the 1934 act was amended in 1950 to permit manufacturing, another decade passed before there were further zone efforts. During the 1960s, new zones were approved for Toledo, Ohio; Bay County, Michigan; Mayaguez, Puerto Rico; and Honolulu, Hawaii. All of these facilities were tied to ocean or Great Lakes ports.

EXPANSION WAVE OF THE 1970s

Interest in foreign trade zones intensified with the international economic developments of the

1970s. It was not until this, the program's fourth decade, that zones first spread inland. Of the 43 new ports of entry granted zones in the 1970s, inland cities accounted for 19.

As a category, "inland" in this paper excludes coastal, Great Lakes-St. Lawrence, and other border cities, all of which have direct transportation services with foreign countries either by ocean carrier or land border-crossing points. At gateway locations, the ports within this rim receive and disperse the majority of U.S. foreign trade, which gives them a naturally greater "zone-use base". [Based on U.S. Customs Service duty collections, the top 10 customs ports of entry in 1978 were New York City, Los Angeles-Long Beach, John F. Kennedy (JFK) International Airport (New York City), New Orleans, Philadelphia, San Francisco-Oakland, Detroit, Boston, Chicago, and Houston, in that order. Except for JFK, whose third-place ranking reflects the high-duty character of air cargo, all were ocean or Great Lakes ports. The number of entries at inland ports is increasing, however, as a result of growth in containerized cargo and the presence of foreign trade zones.] There are currently 31 such cities with approved zones.

It is reasonable to assume that the 19 zone cities that are not within the outer fringe of U.S. land and sea borders have a smaller potential market for their zone services. An exception to this should probably be made for operations of an industrial nature because of the current mobility in that sector; however, because warehousing and distribution facilities remain the prevalent zone service, it remains a valid general hypothesis. It should be noted that a growing number of zone users are industrial firms whose main manufacturing activities are usually outside the zone itself.

To the extent that inland zones have a smaller market, or zone-use base, for their services, size has become a point of departure in distinguishing and analyzing zones. Because smallness tends to be synonymous with failure for some zone watchers, it has become necessary to examine the implications of smaller-scale zone operations. This paper does not attempt to arrive at a precise definition of the small zone because the term is relative. Seaports generally have facilities with at least 200 000 ft^2 of covered warehouse or processing space. One exception is Seattle, which has operated a zone with only 50 000 ft^2 of space for many years. in spite of its smaller size, however, the Seattle zone has helped to project the image of a full-service port. Inland zones tend to set aside zone areas as large as those at seaports, but the normal space for active warehousing activity is more likely to range from 50 000 to 100 000 ft^2. Of course, as industrial-park facilities are activated, the amount of active space increases sharply.

The emergence of the inland zone is in a sense an acceptance of at least short-term smallness. But there must be a minimal level of activity and economic benefit to justify the costs of any public service, particularly a special one with a limited market of users. What is the point at which a zone becomes feasible? What level of activity is needed for financial solvency? What kind and amount of economic contribution to a community are needed to justify a zone?

Answering these questions is not easy. Some services have an impact by virtue of their very availability. Spin-offs and secondary effects must also be considered. Crystal-ball gazing is also involved. Until a community has reached a saturation point in its economic growth (if such a situation can exist), the zone, as a development tool, is part of the future, and projections as to growth and new investment become part of the needed analysis.

Although precise answers are elusive, case studies can be helpful. Because the inland zones are new and still evolving, it is possible to discuss only their early experiences.

Inland zones can be subdivided into two categories: those at river ports and those with no direct water access. There are 10 river-port zones, and all are on the Mississippi navigational system. Once considered land-locked, the nine inland cities are today spared this label because of their nearby international airports and modern methods of moving surface cargo. For this reason, the distinction between the two types of inland zones is not dramatic.

There are other grounds for deemphasizing the distinction. Inland waterways have seldom been used for zone shipments because they transport mainly bulk commodities that are normally not subject to high customs duties. Zones are mainly concerned with manufactured and semimanufactured goods, and this class of merchandise finds its way to inland ports by rail, highway, and air transportation. Of the five river-port zones in operation, all report a modal pattern that shows containers as the prevalent type of cargo and rail as the primary mode used to bring the shipments from the coastal to the inland port.

This does not mean that the availability of inland water transportation is totally irrelevant to zone potential. Most U.S. inland port cities owe their early growth mainly to their doorstep water transportation services. These tend to be the larger inland cities today. The greater overall volume of trade generated by the inland waterway system tends to perpetuate the kind of business and commercial environment that will result in increased demand for international services. In addition, the very presence of low-cost water transportation as an alternative would tend to influence the rates of the competing modes.

This paper focuses on the Mississippi inland waterway system, since that is where the first inland zones were established, but the discussion that follows has application to smaller U.S. foreign trade zones generally, whether they are located at river ports, other inland ports, or smaller port-of-entry communities on the fringes of the outer land and coastal borders. For that matter, many of the comments made here would apply even to the larger zones.

ESTABLISHING THE NEED FOR A ZONE

Although inland ports may be willing to accept a smaller potential volume of zone business, they must arrive at some minimal standard of feasibility and need in justifying their zones. A few words on the requirements for obtaining federal authority for establishing and operating a zone are in order at this point.

In 1934, Congress created the Foreign-Trade Zones Board as an interagency body with the power to license (grant of authority) and regulate zones. The Secretary of Commerce is designated chairman, and the other members are the Secretary of the Treasury and the Secretary of the Army. The program is administered through U.S. Department of Commerce staff, whose director serves as the board's executive secretary.

Applications for zone licenses may be submitted by corporations that are qualified to apply for and establish zones under the laws of the state in which the zone is to be located. Public corporations are given preference. Applicants for zone status must show a need for the zone as a public service in the community in question and present a plan that demon-

strates the ability to finance the project and operate suitable facilities. Once a zone is approved for a port of entry, other zones can be requested only if existing facilities cannot adequately meet the needs of commerce.

Although it is easier to show need in major port areas, the board has interpreted this requirement so that smaller ports are not denied the opportunity to provide this service simply because of size.

In demonstrating "need", an applicant must show both a general basis for the proposed zone and specific user interest. As prospective users cannot be expected to make legal commitments for a service prior to its availability, the evaluation of need is usually made by the applicant and reviewed by the board on the basis of criteria that include expectations and projections and on supporting evidence such as letters of intent. Especially where the focus is on new investment, there is a basis for the contention that, until approval is given, it is not possible to fully measure interest.

At a time when international trade and foreign direct investment are having considerable impact on communities throughout the United States, the Foreign-Trade Zones Board has been willing to acknowledge this sequential difficulty and give applicants the benefit of the doubt on the question of need. This is done, however, only when a zone project is well conceived in terms of the area's overall trade and investment potential and when support from community agencies, as well as state agencies, is evident.

FINANCING

The question of need is inextricably linked with that of financing. The fact that the Foreign-Trade Zones Board, which is not involved in financing zone projects, can be flexible in looking at potential activity does not eliminate the necessity for an adequate evaluation. Whether a public agency or a private firm is to operate the zone, it is usually the party that is assuming the financial burden that bears the onus of making the more critical judgments.

In making these evaluations, it is important to view foreign trade zones in their true perspective. This might mean overcoming some common misconceptions that work against the possibility of a smaller operation. The definition that suggests an isolated facility has sometimes created a false impression of what zones really are. It could be said that there is no such thing as a zone. Under examination we find that zones represent a procedure rather than a physical facility. The term foreign trade zone by itself tells us little about the physical attributes of a project.

Zones are alike in that their customs entry and control procedures are the same. But their physical plants range from warehousing facilities to manufacturing sites, or, as is usually the case, a combination of the two.

At the outset of the program, zones were operated as seaport terminals with emphasis on public warehousing. In time, their activities expanded to include the leasing of floor space to firms that wished to handle their own merchandise. Some years after the manufacturing amendment, the industrial-park zone evolved. Today, most zones include industrial-park space. Public warehousing and floor-space rental are still in greater demand than entire buildings or building sites, but there is growing interest among industrial users, and it is recognized that having space available for even the occasional industrial prospect is a must for most projects. Although most port projects involve a single consolidated facility, some have separate sites for different service needs.

In considering zone financing, it is also appropriate to view zones in terms of their organizational structure, for which there are a number of options. About 50 percent of approved U.S. zones are sponsored and operated by public agencies or by nonprofit economic development corporations on their own property. These projects are normally financed according to the agency's methods of raising capital and under its operating budget.

The remaining 25 projects involve public-type sponsors who contract with private firms for some or all zone services. Here, financing practices are more varied. In about 15 cases, the sponsor leases the zone facility to the operator, who is concerned mainly with the operating costs. The structure of the other 10 projects is more oriented toward the private sector. In those situations, the public sponsor, after determining the need for a zone in the community, typically seeks a qualified private operator who is also to provide the physical facility, or at least the public warehousing portion of it. This type of arrangement is the most recent to evolve, but all of the forms mentioned above are still used throughout the zone program.

These organizational options, combined with the new developments in zone methods, have spun off a more flexible type of foreign trade zone that is part of a composite rather than an isolated operation. This has helped the smaller ports with their projects.

INTEGRATED ZONE OPERATIONS

New methods now make it possible to operate zones as a special service within larger facilities that provide space and services for related general operations. The "integrated" concept fits both public and private types of operations, and it provides the opportunity to reduce zone capital costs and operating overhead.

Integrated operation makes it possible to practically eliminate capital expenditures as a zone cost. The most obvious way to do this is to make a zone part of an existing facility that is already in operation. The only capital improvements in such a case would usually be for the physical security required by the U.S. Customs Service. These expenditures are at least partly recoverable in lower insurance rates. Even for new facilities, capital costs can be considered more as project than as zone costs because the facilities will always have an alternative nonzone use.

REDUCING OPERATING COSTS

Operating expenses are thus the most significant cost concern for the integrated zone. In recent years, the Foreign-Trade Zones Board and the U.S. Customs Service have allowed flexible zone administrative procedures that help to minimize even these costs.

Today, zones are usually planned and authorized on the basis of an "approved" zone area that can be "activated" in increments. In this way, a sufficiently large standby area can be maintained to permit effective marketing. Until the approved area is actually activated, it can be used for compatible nonzone operations as long as it is physically segregated and poses no control or security problems for customs. As the need for zone space grows, approved space can be activated for use as soon as customs requirements are met. During slowdowns in activity, space can be deactivated. This contrasts with older, more rigid operating practices in which facilities were set aside exclusively for zone

activity and there was no distinction between approved and activated space. These procedures are especially useful during a zone's breaking-in period but can also become a necessary standing practice for a smaller zone.

In order to permit this flexibility, the Foreign-Trade Zones Board has since 1972 included a clause in its grants of authority that requires the zone grantee or operator to notify the board's executive secretary before any new manufacturing operations are undertaken. The basis for this is the board's authority to prohibit or restrict operations that are contrary to the public interest. This provision is normally invoked when there is an industry complaint concerning existing operations, but the advance-notice requirement is intended to identify problem cases in advance.

To ensure financial solvency, it is also necessary to plan ahead for expansions and to continually reassess projects so that the changing needs of business and industry are addressed. Procedures for board approval in these cases are relatively simple.

Certain customs procedures available today also help to make this flexibility possible. The U.S. Customs Service is now able to supervise zones under regulatory audit principles without sacrificing control. It sets physical security standards, supervises zone operations on a day-to-day basis, and conducts special periodic audits. The result is an effective, streamlined control system without excessive red tape.

The ascendancy of the integrated zone and the new administrative practices have improved the prospects for zone services on a broader scale but do not relieve a zone of its own financial obligations simply because it can survive as part of a larger activity. There are "zone costs" that the zone should be able to bear. One cost attributable exclusively to a zone is that of customs supervision, a charge for which the U.S. Customs Service is reimbursed by the grantee. Once a zone is in full operation, it can expect a customs overhead cost of from $20 000 to $75 000, depending on the size of the zone, the nature of the activity, and the control system. Other zone costs would be administrative costs attributable to the management expertise required. Since zone managers can be given wider responsibility, however, this can become a shared expense.

The extent to which some zone expenses can be absorbed as part of a total operation will depend on whether the intended secondary effects of the zone as a business stimulant are being realized. Thus, it is important that the total contribution of a zone both to the operation it is part of and to the community be identified in each project.

Even though this broader impact becomes the rationale for operations that may seem marginal, it is a fragile justification because it is not reflected in a zone's financial statement. Whether or not it is a good gauge for this kind of service activity, the summary financial statement filed with the Foreign-Trade Zones Board each year becomes an indicator to the public as to whether a zone is successful. A deficit can result in negative publicity and perhaps the unwarranted implication that a community's business climate is unfavorable. A zone should therefore at least be able to meet its "zone costs" within a reasonable time of starting operations. If it is not, a question arises as to whether its services are in sufficient demand.

PUBLIC-UTILITY ASPECTS OF ZONES

The statutory requirement that zones be operated under public-utility principles has a legal effect on operating income. Rates and charges for zones must be reasonable and uniform. Zone users must be served on a like basis. A schedule of rates and charges is filed with the Foreign-Trade Zones Board and is subject to complaints from users if these requirements are not met.

Since the mandate of reasonableness has not yet been the subject of controversy, the board has not had to define the term. Because zones must compete with other facilities in their communities, the going rates in a particular area for the underlying type of facility that the zone is associated with have a direct relation to the rates charged in the zone. Zone users can be expected to pay higher rates for the special services they receive but, if the rates are too high, users' customs savings are eroded. Although this is a natural deterrent to overcharging and helps to create a self-enforcing situation, the public-utility provision nevertheless remains a cap on profits. This means that, under scrutiny, zone charges must be within a range considered appropriate for this limited type of public-service monopoly.

A zone grantee or operator is more likely to be affected by the public-utility requirement of uniformity. Zone users must be charged the same rates based on the space and services they use. The user who saves more cannot be asked to pay more. This provision reinforces the point that zones exist for the benefit not of the grantee or operator but of the zone user. It is the public economic benefits generated by users that are the objective of the zone program.

Its public-utility feature is an underpinning of a zone's public-service image. When a public or nonprofit sponsor of a zone chooses to contract out the operation of a zone to a private firm, whether on the grantee's or the operator's premises, the public-service obligations are not altered.

SPECIAL-PURPOSE SUBZONES

The subzone is a type of zone facility that does not provide "public" services; the legal justification for this special type of zone is part of an effort to make zone services more widely available to achieve the objectives of the Foreign-Trade Zones Act. When the public zone serving a community cannot accommodate a prospective user because of the type and scope of the user's proposed operation, it is possible under some circumstances for the grantee of the zone to apply to the Foreign-Trade Zones Board for special subzone status for a firm at its own facility. These "private" zones, which are usually industrial plants, are approved only when a clear public benefit can be demonstrated, a requirement that is strictly interpreted. Once a grantee has adopted a policy of applying for this type of facility, it is expected to do so on a like basis for all interested firms.

There are currently five approved foreign trade subzones, and they are involved in the manufacture of oil products, automobiles, motorbikes, typewriters, and women's garments. Three are at inland ports, an indication that inland zones compete equally with other areas in this category. The importance of these self-supporting projects is obvious. The fact that they can be authorized only as adjuncts to public zones is considered one of the important contributions of a public-zone project (where there is a basis for a special-purpose subzone in a port of entry but no need for a public zone, it is possible to become associated with another public zone in the same state).

PUBLIC-INTEREST REQUIREMENT

Another public aspect of zones is expressed in the requirement that their activities should be consistent with the public interest. Any operation that poses a hazard to the public or is harmful to a domestic industry, even though otherwise legal, can be made the subject of a complaint to the board, which has authority to restrict or prohibit such activity. The board's policy understandably calls for a careful review of such complaints.

Although these situations are rare, there has been a dampening effect during the past decade on some zone manufacturing as a result of complaints from the oil, steel, and cattle industries. In the few cases that have arisen, the board has not been required to issue any formal orders because either (a) the activity in question was terminated or the proposal withdrawn or (b) action was taken by some other government agency.

This provision has been of concern to zones because of the element of uncertainty it poses for manufacturing and processing operations. The few cases that have arisen would suggest that, although the public-interest requirement is a limitation on zone activity that must be taken into account, it poses no cause for alarm. Even if this caveat had not been expressly stated in the act, the board would probably have interpreted its powers to include this authority.

INLAND ZONES ON THE MISSISSIPPI SYSTEM

The first four inland zones, authorized between 1972 and 1975, were all established at sites on the Mississippi River and its tributaries: Little Rock, Arkansas; Kansas City, Missouri; Kansas City, Kansas; and Omaha, Nebraska. In October 1976, Wilkes-Barre/Scranton, Pennsylvania, became the first inland zone not at a river-port city. The remaining inland river-port zones approved after January 1975 are at the following ports of entry: Louisville, St. Louis (Granite City, Illinois), Pittsburgh, Cincinnati (sites in both Ohio and Kentucky), and Tulsa, all on the Mississippi system. The other inland cities with zones are Atlanta; Newburgh, New York (New York City port of entry); Spartanburg, South Carolina; Dallas-Fort Worth; Orlando, Florida; Battle Creek, Michigan; and Salt Lake City.

Because of the preponderance of the inland zones on the Mississippi system, this group provides the basis of our case study. The study focuses on the three sites that have been in operation for more than two years: the two Kansas City zones and the one in Little Rock.

Kansas City, Missouri, and Kansas City, Kansas

The first inland zone became operational in 1974 in Kansas City, Missouri. Zone 15 consists of three separate sites, sponsored by the Greater Kansas City Foreign-Trade Zone, Inc. (GKCFTZ), a Missouri nonprofit corporation spawned by the Greater Kansas City Chamber of Commerce in 1972.

The largest of the three sites (site 2) is located in an expansive underground distribution complex known as the International Trade Center. The facility is situated near the intersection of the city's beltway (I-435) and MO-210, within 10 min of downtown. The site is also directly serviced by rail and has switching services to 12 main-line railroads. Barge landings on the Missouri River are within a 10-min drive. Underground Development Corporation, a subsidiary of Great Midwest Corporation, is the operator and owner of the facility, which is an integral part of the 344-acre International Trade Center complex.

Site 2, which is now in its sixth year of operation, last year received more than $33 million in goods for 55 tenants involved in light processing, storage, and distribution activities. The shipments included electronics equipment, housewares, machinery, electrical items, wines and spirits, and chemicals. Although the facility has direct access to the inland waterway system, except for some occasional shipments of bulk chemicals by LASH barge, incoming shipments are almost exclusively containerized shipments that are transported to U.S. seaports by ocean carrier and that arrive in the area by rail. They are then trucked to the zone from local rail terminals. There are occasional air-freight shipments. Shipments from the zone are primarily for the domestic market; 7 percent (by value) is destined for overseas markets.

Operations at the site have grown over the years. Fifty-five firms currently use the zone compared with 18 in 1975. Merchandise shipments have increased from $15.8 million in 1975 to the $33 million received in 1979. Tonnage has increased from 5000 in 1975 to 13 200 in 1979. More than 270 000 ft^2 of zone space is active, twice that in 1975. Another 100 000 ft^2 is slated for activation in early 1980 for a television processing operation.

Site 1 of zone 15 is a conventional warehouse whose zone space has never been activated. This facility was requested so that a site with normal ceiling height would be available (the underground facilities have a ceiling height of only 16 ft).

Site 3 of zone 15 is a privately owned and operated warehouse and processing facility near the Kansas City International Airport. It was activated during 1977 for limited activity that mainly involved a shipment of citizens band radios valued at $8 million and weighing 340 tons. Since then, the facility has been used only for nonzone activity. The facility was requested to provide service for air-freight shipments near the airport. Thus far, it has been used mainly for standby service.

Shortly after approval of its Missouri zone, the grantee of zone 15 was authorized by the Kansas legislature to apply for zones in that state. To provide each of the two Kansas Cities with its own zone, GKCFTZ applied for and received a second grant of authority for a site in Kansas City, Kansas. This site, like site 2 of zone 15, is part of an underground warehouse and processing facility. The approved zone area covers 405 000 ft^2 within the 4 million-ft^2 facility owned and operated by Inland Storage Distribution Center, a division of Beatrice Foods, which also has customs-bonded space at the site.

Since the zone began operating in 1975, some 81 000 ft^2 of the zone area has been activated. Shipments into the zone have risen from $1.5 million in 1975 to $4.5 million in 1979, although the $8.4 million in goods received in 1977 indicates cyclical demand. Only seven companies have used the zone, all for public warehousing. The commodities received have included machinery and components, electronics items, optical equipment, bearings, footwear, sports equipment, film, jet engines, and foodstuffs.

The prevalent modes of transportation to the zone are rail and highway, and shipments are moved to the site in containers. More than 40 percent of the zone's outward shipments (by value) were for export.

Measuring the full impact of the Kansas City area zones is not easy. It appears that public and business officials give the zones high grades as part of the area's recent success in its international trade and investment efforts. Although the

city has been a port of entry for almost a century, the zone's duty-free port image has helped to draw attention to the area's port-related capabilities. This is reflected in significant increases in customs entries during recent years.

Because demand for actual zone services has not been unusually heavy, the problem of financing has been of concern to both the grantee and the site operators. At this point, site 2 of the Missouri zone is considered the bellwether.

Because the site is operated as an integral part of the Great Midwest Corporation facility, there are no significant capital costs. Improvements are made after tenants are committed. It is operating costs that are the main financial concern. Annual zone expenses last year amounted to approximately $60 000, of which 40 percent represented the site's allocated share of the customs reimbursement. The remainder was for administrative costs paid to the grantee, GKCFTZ.

The grantee considers a minimum of 250 000-300 000 ft^2 of activated zone space to be the break-even point for this site. According to Studley of GKCFTZ, zone rates and charges range from $1 to $5/$ft^2$, depending on the type of facility required and the services needed.

Promotional expenses are considered an additional zone cost at this site. The extent to which promotional efforts contribute to the benefit of the overall operation is apparently not measured. Without a system for identifying such spin-offs, overhead costs that have a broader impact tend to fall on the zone alone, adding to its financial burden.

Little Rock

The next port on the Mississippi system to inaugurate zone services was Little Rock, Arkansas, which opened for business in December 1975. Zone 14 started as a public warehouse at the Little Rock Port Authority's dockside transit storage building on the Arkansas River but was recently moved to a nearby industrial park. Sponsored by the Arkansas Industrial Development Commission, the zone is considered one of the state's important marketing tools for international business development in the Little Rock area, which became a customs port of entry in conjunction with the opening of the Arkansas-Verdigris Inland Waterway System in 1970.

During the zone's first full year of operation, it received only small shipments valued at $125 000. Over the past two years, there has been a gradual but significant increase in shipments. During the past year, the zone has received goods valued at $1.5 million, including machinery, watch parts, brass tubing, antiques, electronics items, and roofing material. Thus far, it has been used for public warehousing.

The zone, which is now located on a 25-acre site within the port's industrial park, has a new 104 000-ft^2 warehouse and processing building. This will make a wider range of services available to zone tenants, including firms that want their own building.

The port authority runs the zone as an integral part of its port terminal and industrial park complex. About 17 000 ft^2 in the new building has been activated as zone space; the additional space is being used for related nonzone activity.

Thus far, the Little Rock experience reinforces the premise that zone tenants are not likely to be users of the inland waterway system. Here, as at the Kansas City facilities, there has been only negligible use of the waterway system by zone tenants even though it is at their doorstep. Shipments arrive mainly in containers from New Orleans by rail. A small amount of cargo arrives at the area's airport, within a mile of the zone.

Despite its present smallness, the Little Rock zone is considered economically feasible by its sponsor and operator. The ability to operate the zone as an integrated activity has been a major factor. The recent move and expansion have greatly improved its potential by eliminating the severe marketing restrictions experienced at the original site.

All three zones have been in operation over too short a time to permit a meaningful evaluation of what their long-term public contribution will be. It appears that a financial equilibrium has been achieved by all three projects through full use of the integrated concept.

The Little Rock zone's more public structure seems to have resulted in a greater acknowledgment of the zone's ripple effect, largely because of the state of Arkansas' direct role in encouraging new economic development at the new river port. The recognition of the facility's secondary effects has been the basis for at least a temporary acceptance of a small zone operation.

The fact that both Kansas City area zones represent the more private of the operational options explains their contrasting attitude toward secondary factors. Both are located at facilities owned by private operators. This entails the benefits of private entrepreneurship, but it means that there is more pressure for short-term results. Although the operators need not leave "approved" zone space idle while awaiting new business, they are not as apt to assign value to indirect impact on their overall operations so as to allow the sharing of costs. Thus, these projects tend to have to achieve a higher level of zone use within a shorter time if they are to be considered profitable. The Kansas City area zones carry a burden that most others do not in that they bear a proportionate share of the nonprofit grantee corporation's administrative expenses. For this, of course, they obtain the benefits of some new business referrals. The financial burden is less demanding where the grantee is an agency that administers the zone as one of the many activities under a general operating budget and other sources of income.

Thus, the Little Rock structure is more supportive of the smaller zone, easing its growing pains. Kansas City's solution is more aggressive marketing by the operator, which has moved both sites beyond the minimum 50 000 ft^2 of income-generating zone space that would seem a lower limit in these situations. The fact that the Kansas site has chosen to continue providing bonded warehousing along with zone services has been a factor in its activating considerably less zone space than the Missouri site, which will soon exceed 350 000 ft^2. The greater emphasis on processing and assembly activity at the Missouri site has affected its development.

Other Mississippi System Zones in Operation

Of the remaining zones on the Mississippi inland waterway system, two others have started operations during the past year. Zone 19 at Omaha opened at the grantee Omaha Dock Board's municipal dock terminal facilities on the Missouri River. The zone, currently a 20 000-ft^2 building, is contracted to the Omaha Dock Board's terminal operator, which runs the zone as an integral part of its activities. Only two shipments, valued at $43 000, were received during the past year. Plans call for eventual expansion to the Riverfront Industrial Park, which is under development nearby, adjacent to Eppley Airfield.

Zone 47 (Campbell County, Kentucky), approved in January 1979, is located off I-275 within 7 miles of downtown Cincinnati and 12 miles of the Greater Cincinnati Airport. A nonprofit affiliate of the Greater Cincinnati Chamber of Commerce is the zone grantee, and the Northern Kentucky Port Authority acts as administrator.

Zone 47 has two sites only 1 mile apart. One is at the port authority's 17-acre E.J. Kneffle Industrial park, the other at the 21-acre warehouse and distribution complex of Hosea International. The Hosea International site started its zone activity in a 45 000-ft^2 warehouse in September 1979. During that month, shipments of automobile glass and jewelry weighing 25 tons and valued at $192 000 were received from Germany and Finland. The fact that this zone was able to start operations within 8 months of approval, instead of the normal 12-18 months, indicates a sound project as well as the advantage of making zones part of ongoing operations.

CONCLUSIONS

Economic developments in recent years and changes in transportation technology have transformed the roles of inland U.S. ports. Demands for new services have arisen in these communities as the patterns of cargo movement have changed and a new generation of industrial plants has begun to emerge. Their port and economic development agencies must now extend their efforts, from improvements in physical facilities and handling services to the growing need for supplemental services, including those related to international trade and investment. The fact that inland ports generally have a smaller use base for international trade services makes planning for these public services more demanding. It is into this changing environment that the new, smaller inland foreign trade zones have settled.

Some would say that, in the creation of these zones, necessity has once again been the mother of invention--i.e., if smaller zones are to be successful, new methods are necessary and, in fact, have evolved. Others would suggest that the more things change, the more they remain the same--i.e., the small zone is not really new but is simply becoming more commonplace. In any case, what one sees evolving is a growing acceptance of the smaller zone, which is being developed and used in a way that can extend its reach and give it a dimension that exceeds its physical size.

The integration of zones into larger related projects has been one factor in making the small zone workable. Another has been the ability to maintain larger zone areas for marketing purposes, even in a zone's early stages before its full potential is realized. Streamlined U.S. Customs Service procedures are also part of the equation.

New procedures and methods make it possible to view zones in their true perspective--i.e., so that the emphasis is on their procedural services rather than their physical attributes. This more comprehensive view makes it possible to parlay the presence of a zone and the availability of its special customs procedures into a condition that, in effect, bestows on a port a "duty-free" status. Size limitations, in other words, are temporary, for zones can adapt to meet the changes in demand for their services.

The small zone's justification thus becomes a recognition of its total impact and medium- or long-range value. Just as patience is necessary in longer-term economic development planning, so is a certain modesty needed to accept some of the smaller steps taken in achieving planning objectives. We must overcome the notion that a free trade zone is without value unless it is prodigious in size. A zone's full value is not determined by its size but by how and to what extent its availability is harmonized with the broader efforts of the community in creating and projecting a favorable climate for international business.

The option of small, yet feasible, foreign trade zones has made it possible for a larger number of port communities to include zone services in their overall efforts, and this has improved their opportunities for sharing in international trade and related investment.

REFERENCES

1. Mid-America Ports Study. U.S. Department of Commerce, June 1979, Vol. 1, Chapters 9, 19, 20.
2. National Transportation: Trends and Choices (to the Year 2000). U.S. Department of Transportation, Jan. 1978. NTIS: PB 282 230.

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