

Table 1. Projected waterborne commerce at the Port of Louisville between 1980 and 2030.

Commodity Group	Megagrams (000 000s)							
	1980	1985	1990	1995	2000	2010	2020	2030
Total receipts	8.766 37	11.535 99	13.124 39	15.316 25	17.278 37	22.503 28	29.873 89	39.019 26
Coal and lignite	1.561 02	2.193 26	2.580 73	3.300 19	4.249 78	6.553 63	10.290 95	15.421 67
Gas, jet fuel, and kerosene	3.272 26	4.013 07	4.278 91	4.753 89	5.212 92	6.341 30	6.378 89	6.394 28
Fuel oil	0.778 64	1.042 56	1.358 12	1.725 32	2.144 16	3.136 75	4.335 89	5.741 58
Aggregates	1.505 82	1.996 95	2.219 68	2.361 69	2.200 13	2.265 44	3.475 35	4.747 41
General cargo	1.648 63	2.290 15	2.686 95	3.175 16	3.471 38	4.206 16	5.392 81	6.714 32
Total shipments	1.125 05	1.407 93	1.694 62	1.983 77	2.274 41	2.857 76	3.442 06	4.029 98
Coal and lignite	0.706 20	0.976 11	1.246 04	1.515 95	1.785 87	2.325 71	2.865 54	3.405 38
Gas, jet fuel, and kerosene	0.021 07	0.011 70	0.006 13	0.003 03	0.001 42	0.000 25	0.000 04	0
Fuel oil	0.081 45	0.072 97	0.064 47	0.055 98	0.047 49	0.030 51	0.013 54	0
General cargo	0.316 33	0.347 15	0.377 98	0.408 81	0.439 63	0.501 29	0.562 94	0.624 60
Total local movements	0.095 01	0.101 75	0.110 65	0.121 69	0.134 89	0.167 74	0.209 20	0.259 25
Total	9.986 43	13.045 67	14.929 66	17.421 71	19.687 67	25.528 78	33.525 15	43.308 49

Note: 1 Mg = 1.1 tons.

orderly collection and analysis of the factors considered relevant to the study as limited by the availability of projected values for the selected factors. It is believed that these study methods could be applicable to other, similar studies that may be undertaken in the future.

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opinion of the U.S. Army Corps of Engineers or of the firm of Allen and Hoshall.

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Abridgment

Statewide Waterborne Commerce and Port Development Planning

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The majority of our country, both in geographic territory and population, is accessible via its inland, coastal, and Great Lakes waterway system. Yet the approaches to port development of the states possessing elements of this vast transportation system vary from benign neglect to extensive funding, construction, and operation of ports and port facilities. This paper briefly describes Missouri's approach.

The state of Missouri is strategically located on the nation's 40 322 km (25 000 miles) of navigable waterways. The Mississippi River system comprises almost 14 516 km (9000 miles) of this total, with over 1613 km (1000 miles) being either within or bordering on the state of Missouri. Missouri's waterway system is complemented by good highway and rail networks covering the state. On this waterway system, Missouri possesses in St. Louis the largest inland waterways port in annual tonnage. Yet, even possessing this complete transportation system and large

port, most port development has just happened in Missouri instead of being created.

Missouri's involvement in port development began with the new Missouri Department of Transportation (DOT), created in July 1974 as one of the 14 state departments under reorganization. Within the state DOT, the plan of organization is based on modal divisions, including the Division of Waterways. In addition to the constitutional and legislative powers of the department, the division is responsible for the administration of Missouri's port legislation concerning the creation of port authorities.

Under this legislation, cities and counties situated on or adjacent to or embracing within their boundaries a navigable waterway are authorized to create port authorities. On approval by the Missouri Transportation Commission, these port authorities become political subdivisions of the state and possess the powers granted by these statutes. Additionally,

statutes mandate the development and implementation of a statewide waterborne commerce and port development plan. This plan has just been completed by A. T. Kearney, Inc., and provides the basis for this paper.

DEVELOPMENT OF RIVER PORTS

River ports, unlike deep-sea ports, are made up of collections of large processing plants in basic industries and distribution facilities for bulk products. Most river port development has been initiated by private companies. However, local port authorities have enhanced development by creating riverside industrial parks. These parks have been built with local public money and represent a significant investment for most communities. Aggressive local support has been a prerequisite for their success.

Instead of containing large cargo terminals and warehouses designed to transfer cargo from one mode of transportation to another, river ports primarily consist of a series of riverside manufacturing facilities and storage terminals supported by captive cargo docks. Users of barge transportation tend to be companies in heavy processing industries whose shipments originate and terminate at large, capital-intensive production plants and storage terminals. Because of a lack of adequate port planning, this situation often precludes the use of established public cargo-handling facilities and thus causes strip development of private "one plant-one dock" facilities up and down rivers. As an example, 72 of the 86 cargo docks in the Port of Metropolitan St. Louis are dedicated to a single user.

Although the private sector has initiated most river port development, public bodies have also been active in stimulating river-related economic growth. An extensive survey conducted during this study found no standard approach to public involvement in port development. Some states have concentrated development activities in statewide corporations or government departments; however, most states have followed less centralized approaches that allow counties and municipalities to form local port authorities.

Local port authorities offer several distinct advantages for industrial development interests. They are ongoing organizations that specialize in planning and promoting river-related economic development. In addition, port authorities typically are vested with public financing mechanisms used to prepare property for industrial tenants (general obligation and industrial revenue bonds). They typically have eminent domain powers to consolidate land parcels and occasionally are able to provide tax shelters as an incentive to attract new developers.

Some states, particularly in the southern United States, have aggressively used local port authorities as tools to help draw new industry to their areas. In isolated cases, some port authorities have even expanded successfully into a wide range of non-river-related activities, e.g., the hospital construction activities of the St. Paul Port Authority.

Since World War II, prominent port authorities have elected to build riverside industrial parks in addition to establishing public cargo transfer docks. These parks offer a host of advantages to prospective corporate tenants including flood-protected sites, road and rail connections, water and sewer systems, electric power lines, natural gas pipelines, and industrial security.

Many of these services--particularly utilities--are difficult to find in river valleys or even in developed urbanized areas. This fact, combined with the opportunity to share service costs, has been a strong locational incentive for companies seeking new waterside plant sites.

Recent increased public concern over water pollution, environmental protection, and employee safety has enhanced the desirability of the industrial park over scattered individual developments. Parks tend to prevent wasteful "strip development" of rivers by concentrating plants in small areas and thus permitting people to use the greater bulk of riverfront land for parks, marinas, and other recreational or agricultural purposes. In addition, parks with numerous tenants can justify the purchase of sophisticated safety equipment such as oil-spill cleanup devices and fire-fighting equipment. For these reasons, waterside industrial parks should continue to act as magnets for new river-related industrial facilities.

Concentrated park development also opens the door for substantial improvements in transportation productivity through the use of efficient, jointly shared cargo dock facilities. The 1976 Maritime Administration study of the Port of Metropolitan St. Louis found that new park developments could achieve a one-third reduction in port operating costs through the use of shared barge-handling docks that are linked to park tenants by material-handling connections such as conveyors and pipes. Parks offering such options should have a competitive edge over other, more traditional parks or industrial sites in attracting future tenants.

In the past, port industrial parks have taken a long time to develop and have required extensive capital expenditures. Local property owners have made these investments by allowing general obligation bonds to be issued. Because such bonds are paid for by local property taxes, the issuances are subject to voter approval and a number of years may elapse before a public consensus can be formed for such an investment.

Construction costs have doubled in the past decade and consequently river port development represents a major investment decision for medium- and small-sized communities today. In fact, many rural counties in Missouri would have to pool their financial borrowing power to undertake new port development on their own. This large increase in cost has been one of the major reasons for the recent increase in state involvement in port development.

States that take a decentralized approach to port development have traditionally passed port authority enabling legislation and then followed a hands-off policy, allowing local groups to shoulder the development burden. Recently, however, state agencies have begun playing a more active role by preparing statewide development plans, providing technical assistance to newly established port authorities, and acting as liaison between federal agencies and local ports. In several instances, states such as Kentucky and Louisiana have provided outright money grants to local port authorities. In almost every state, economic development departments are helping to market local port development sites. For example, a portion of Oklahoma's \$400 000 annual promotional budget, a Tulsa hotel sales tax, and the port's own advertising funds are used to promote the Port of Tulsa. Recent trends in industrial development indicate that states with river development opportunities will continue to play a more supportive role in the future.

Three keys to successful port development begin to emerge from this discussion. They are aggressive local interest, financial commitment, and skilled direction in the beginning. 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. Because port development usually involves heavy facility construction, the critical decisions that affect the success of a port are

made before building begins. Once dock facilities and other structures are in place, it is normally too late to go back and correct mistakes.

RECOMMENDATIONS

Based on the foregoing discussion of river port development and the statewide study, Missouri is pursuing a much more active approach toward port development than in the past. It is believed that, since the approach is not necessarily state specific, some of the ideas would be applicable and beneficial in furthering port development in other states.

Numerous activities recommended in the study have either been implemented already or are in the process of being implemented. These recommended activities are in five functional areas: organization, planning and administration, finance, promotion, and national issues.

Organization

1. Missouri will retain its existing port organization based on local port authorities. Other states have been successful in using this approach, and there is no apparent gain in establishing a statewide port authority or some other organization.

2. The Missouri DOT is encouraging the formation of a port authority association. Port associations in the state of Washington and in other areas of the country have proven effective in solving mutual problems faced by local port authorities. A similar association in Missouri could speed overall port development.

Planning and Administration

1. The Missouri DOT provides planning and managerial guidance to interested port authorities. Information activities will include the sponsoring of seminars and the preparation of operations manuals on site selection, engineering, and industrial park administration. These are but a few of the areas in which local port authorities may require assistance during the initial development period.

2. Next, the state DOT provides technical assistance to port authorities and interested local government agencies on request and on a regular basis. Where direct staff assistance is reasonably practical, DOT personnel support local port staff functions. For example, the staff helps prepare grant applications and review engineering reports. To foster this, a DOT representative calls periodically on each of the port authorities.

3. The Missouri DOT ensures that all state agencies affected by port development have a chance to review and comment on proposed developments while they are still in the early planning stages. Interested parties are occasionally left out of early planning. Consequently, strong protests from the excluded interest groups create problems that could have been avoided before considerable time and money were invested. Conservation, natural resources, agriculture, and highways are some of the agencies that are included as interested parties.

4. The Missouri DOT acts as liaison between federal agencies and local port authorities. DOT members have established many contacts with the U.S. Army Corps of Engineers, the U.S. Department of Commerce, the U.S. Department of Transportation, and other agencies. The state DOT fosters and uses these contacts to help local port authorities in their dealings with other government agencies.

Finance

1. The state DOT has asked the Missouri Legislature to amend the existing port act so that port authorities can issue general obligation bonds and levy limited local taxes. Both would be subject to local voter approval when the general obligation bonds would be used for initial construction and the tax revenues would be sufficient to cover early administrative costs.

2. The state DOT has asked the Missouri Legislature to appropriate funds for temporary "seed" grants to local port authorities. The authorities could then use the money as matching funds for federal grants to help pay for construction and development. The Missouri DOT will be responsible for allocating the money to local port authorities based on applications for worthy projects.

Promotion

The Missouri DOT and the Division of Commerce and Industrial Development are developing and pursuing a promotional marketing program focused on river-related industrial development opportunities. The program will include trade journal advertisements, direct calls on corporate officials, and responsive assistance provided to parties interested in locating in Missouri.

National Issues

Nationwide interest groups have placed a spotlight on several special issues whose outcome could have a dramatic effect on Missouri's port industry. These issues include Missouri River development, waterway user charges, and the replacement of Locks and Dam 26 at Alton, Illinois. The environmental sensitivity of the natural habitats along the Missouri River and the possible increased consumption of river water from upstream reservoirs in conjunction with unfavorable navigation characteristics and a short operating season may discourage large industrial development along the Missouri River.

Waterway user charges, which appear inevitable, may come either as a fuel tax or as segmented tolls. The enactment of segmented tolls would increase the costs of barge transportation on the Missouri River to the point that navigation would effectively cease and a greater burden would be imposed on the Mississippi above St. Louis. Therefore, the fuel tax approach appears to be the lesser of two evils for Missouri barge shippers.

Congress may approve this year the replacement of Locks and Dam 26, which has become a transportation bottleneck. Although nonreplacement most likely would spur short-term attraction of companies to St. Louis and points south to avoid shipment through Locks and Dam 26, the resulting long-term depression of the barge industry would probably do more harm than good to barge shippers in Missouri. Also, possible failure of the facility would be extremely harmful to Missouri shippers. Clearly, the state of Missouri has a strong vested interest in these national issues and will lobby vigorously for their favorable resolution.

CONCLUSIONS

In addition to these recommended activities, the study identified 17 industries and six locations that have a potential for port development in Missouri. Capitalizing on the identified opportunities could more than double Missouri's port industry. By the year

2000, barge cargo, river-related property taxes, and shipper savings for export grain could be increased substantially. Primary and secondary employment could be increased by as much as 75 percent. A 9 percent increase in employment and a 7 percent increase in the property tax base are possible for the state's total economy through river port development. Clearly this represents a substantial economic stimulus for Missouri.

While river port development generates a wide range of general economic benefits, financing for the proposed development program has been analyzed conservatively and as a business proposition for state government. Spreading new plant opportunities evenly between the years 1980 and 2000 resulted in an approxi-

mate increase of \$1 270 000/year in state tax revenues and an increase of \$1 350 000/year in local property taxes. A benefit/cost analysis (using a 10 percent cost of capital) was then performed on these time-phased cash flows. If this is viewed strictly as a business venture between now and the year 2000, state government could invest up to \$9 000 000 annually in port development and recover it completely through increased state revenues. Clearly, the opportunity is there; all that needs to be done is to pursue it, and that Missouri will do.

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Abridgment

Effects of Technological Improvements in Loading and Unloading Containers and Shipborne Barges on Design of Equipment and Inland Ports

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The inland waterway system of the central United States is serviced by the Port of New Orleans, the second largest port in the nation, and by the Port of Baton Rouge, the fourth largest U.S. port. This system includes some 31 000 km (19 000 miles) of waterways that converge at New Orleans and has resulted in a total freight movement through the lower Mississippi of 368 million Mg (405 million tons) in 1975. The value of the trade in 1975 was \$19 billion. This movement was accomplished by both ships and barges. In 1975 there were 13 366 ocean-going vessels and over 190 000 barges moving over these waterways through the New Orleans area.

LASH/SEABEE

The LASH concept was developed by a New Orleans firm, Friede and Goldman, Inc. In addition, Avondale Shipyards, located in the port area, has constructed 20 LASH vessels, and Equitable Equipment Company, located in the port area, has constructed over 3000 lighters or LASH barges. Currently, there are 13 LASH vessels operated by 5 different steamship companies and 3 Seabee vessels operated by one steamship company—all operating from the Port of New Orleans.

LASH/Seabee developments have truly been spectacular. In a period of just 5 years, over \$500 million has been invested in LASH motherships and lighters for operation out of the Port of New Orleans. Another \$225 million will be spent on construction of LASH motherships in the near future. The Port of New Orleans is now the largest LASH port in the world, and this revolutionary trend is continuing at a rapid pace.

In 1975, LASH cargo movements in the Port of New Orleans accounted for 7 percent of the total general cargo, and projections indicate that before the year 2000 one-third of the total general cargo throughput will be handled by this mode. This is truly a remarkable revolution considering that in 1969 no cargo was using this mode.

CONTAINER HANDLING

Until recent years, conventional general cargo wharves in the Port of New Orleans were not designed for handling containers. Since the Port of New Orleans owns land with areas sufficient for the marshalling of containers along the Inner Harbor-Navigation Canal, a master plan for development of 113 hm² (280 acres) was prepared. The France Road Terminal, ideally located at the intersection of the Inner Harbor-Navigation Canal and the Mississippi River-Gulf Outlet, is half complete. The terminal is served by roads, railroads, and I-10.

The movement of containers is not limited to full containerships. Containers move on inland waterways by barge to be loaded on LASH or Seabee vessels. They move by rail, highway, or air to be loaded on the decks of many types of vessels.

A convenient form of shipment of containerized cargo involves what is referred to as roll-on/roll-off (ro/ro). Containers or "piggybacks" can be driven onto or from vessels via specially designed ramps and piers. This form of container movement eliminates the need for a crane, and vessel turnaround time is excellent. The ro/ro operation represents progress in door-to-door shipment of general cargo. The effect of this new mode of shipping on the port has been in the form of modifications to general cargo wharves where there is sufficient area for the marshalling of the containers. The facilities at Dwyer Road and Florida Avenue on the Industrial Canal have been augmented to accommodate the ro/ro operations.

In order to supply the throughput of containers to the vessels previously discussed, intermodal facilities for handling containers have evolved in the port area. Many of the rail yards that previously contained boxcars loaded with breakbulk cargo now contain trailers on flatcars and containers on flatcars.