Need for a Port Planning Methodology

Lonnie E. Haefner, Department of Civil Engineering, Washington University
John Mitchell and Dave Wuenscher, Real Estate Research Corporation, St. Louis

This paper reviews waterway and port development within a set of complex institutional, governmental, and intermodal issues. The lack of a policy statement relating port facilities to national transportation needs and planning activities and the widely varied investment criteria for port-related transportation facilities (highways, rails, and public transit) have established an environment conducive to overinvestment in regional port facilities. This paper develops a commodity flow analysis and reviews potential implementation and funding options and the integration of ports into federal transportation activities and the regional and metropolitan transportation planning process.

The object of this paper is to assess the need for formalizing port and intermodal planning mechanics into regional transportation and public works planning. To date, waterway and port planning and the provision, funding, and timing of related facilities have received little attention in formal transportation planning evaluation and implementation, and in capital and operating guidelines in dealing with regional planning, A-95 activities, and categorical or block funding. The result has often been overinvestment in regional port facilities. In addition, investment criteria for related transportation modes (highway, rail, and public transit facilities) in and adjacent to port and intermodal areas vary widely, causing difficulty in processing the package of transportation facilities required for a particular port or intermodal site and making assessment of possible benefits difficult. Finally, no concrete statement of policy as to the place of port facilities, their planning, study, or subsidy characteristics has emerged in national transportation needs and planning activities. As such, the specific objectives of this paper are

1. To conceive the port, its goods movement, and the associated private and public land uses and activity generation as a complex entity, embodying all facets of transportation planning analysis;
2. To develop a regional and site-sensitive goods-movement forecasting model that is compatible with analysis of sunk-cost types of public and private investments as found at port and intermodal sites;
3. To catalog the current funding and guideline deficiencies in dealing with port planning implementation and to overview some implementation and funding options; and
4. To offer tentative conclusions as to the place of port planning in federal transportation activities, and the structuring of port planning in regional or metropolitan transportation planning processes.

THE PORT AS A COMPLEX ENTITY

A port is historically designed or created to exploit the break-bulk capabilities of a region or metropolitan area due to the presence of a waterway. Ideally, port sites are located and developed to do one or more of the following:

1. Complement the use of other modes in the movement of goods;
2. Develop a geographic focus for origin, destination, or change-of-mode for specific cargo types;
3. Cater to specific high-volume, high-bulk, low-priority components of commodity flow such as grain and coal;
4. Improve the regional marketing position of a metropolitan area by extending the market radius of goods by alteration of transport costs or by capture of market inventory currently diverted elsewhere;
5. Provide a regional stimulus through increased agricultural, industrial, and construction employment; and
6. Alter and solidify private sector land use planning in the vicinity of the port. This last objective can be accomplished by offering planned industrial and commercial sites to users who could benefit from proximity to a port location in terms of their raw material, market, or transport activity orientation. A critical result of this process is the alteration of land values and the real estate market structure in the area. Thus, the port may be one type of anchor for the community land use planning process.

The above objectives of port development will have different combinations and strengths in each individual location. All are theoretically significant and should be understood in the context of the port as a complex entity (1).

THE PORT SYSTEM AS A MICROCOSM OF THE TRANSPORTATION PLANNING PROCESS

The reason for port planning is to couple the transportation facilities (water and ground) into a complex entity. As shown in Figure 1, the port process is a microcosm of all of the related activities of transportation planning. The availability of water goods movement allows break-bulk activities and results in intermodal transfer of commodities by rail, truck, or air and causes traffic flow alterations. The stimulus of a port location causes basic and nonbasic industrial siting in its vicinity, the associated commercial services, and possible potential for residential land use shifts. These land use alterations will generate ground transportation person and goods trips of employees, users, and commodities from the site complexes, and further alter regional origin-destination distribution, route choice, and traffic flow patterns.

Thus, all of the facets of site and transportation planning activities are involved in this process. Specifically these are forecasting goods and person trip generation; forecasting land use; forecasting trip distributions, route assignments, and traffic flows by mode; and providing transportation supply to serve the following activities: port proper facilities (wharves, crane and transfer facilities, transit sheds and tanks), rail yard and rail line-haul facilities, air freight services as needed, local and long-haul truck delivery capabilities, parking, adequate highway capacity and interchange capabilities for the appropriate highway class, and appropriate and compatible mass transit capabilities.

These activities are sensitive to the forecasts of goods movements at the site and the funding sources available to implement appropriate facility investment levels. The development of a comprehensive and sound port planning process must integrate a meaningful and locally sensitive forecasting approach with well-understood guidelines with respect to project investment and funding mechanics.

DEMAND AND REGIONAL GROWTH ISSUES

The investment required to develop port and related transportation systems is not only substantial but is also a sunk cost in that only minimal adjustments of capital investment strategies are available after construction thresholds have been implemented. Realistic forecasting techniques of the anticipated demand for commodity movements must be used to ensure optimum capital development. Properly planned and implemented, the development or expansion of port facilities will provide significant regional benefits.

Economic activity is a primary determinant or generator of the transportation flow of any commodity. Each of the modes of transportation, with its inherent capabilities, economics, and resulting advantages and disadvantages, competes with the others for the movement of various commodities, and the development and technological innovation of transportation systems in turn provide other economic growth opportunities.

The relation between historical trade flows of a specific commodity and the level of economic growth in producing and consuming sectors is the basis for the forecast of the volume of future flows. Techniques for

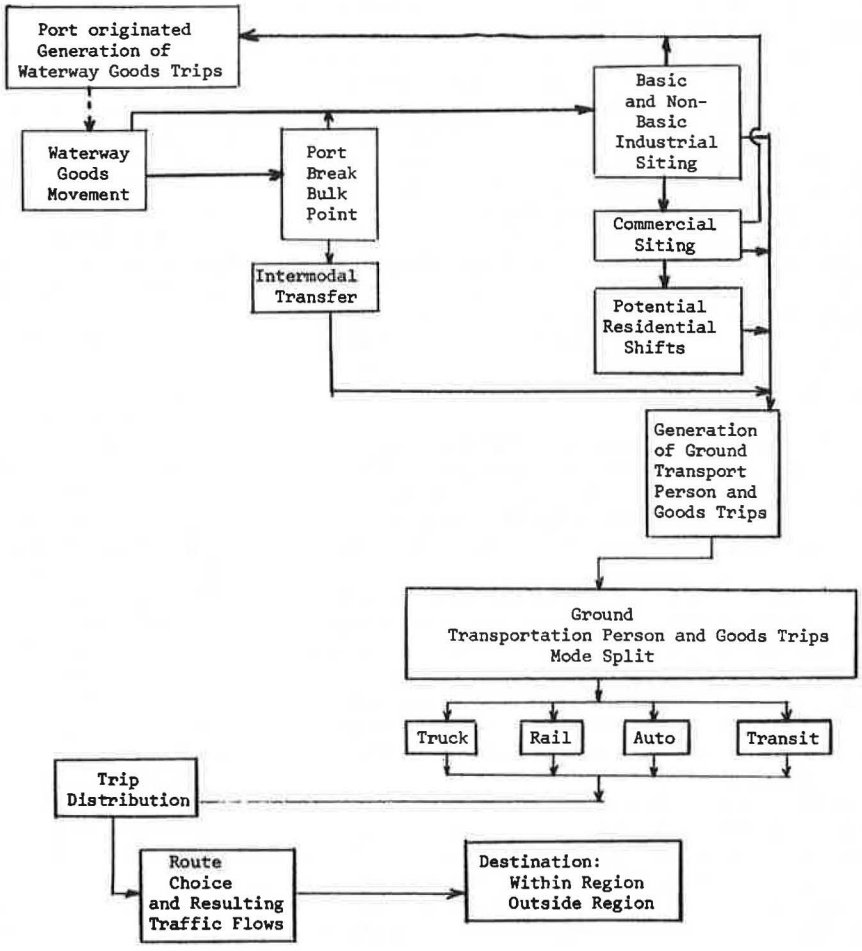

Figure 1. The port as a microcosm of the transportation planning process.

forecasting commodity movements by mode must be able to identify specific regional economic growth prospects and incorporate local economic analysis with commodity trade flows and projections of the volume, share, and shift between competing modes.

There are several problems in attempting to correlate commodity flows with the economic analysis of the industrial hinterland related to a specific port location. First, there is the need to assemble a data base for the specific local area and the corresponding problem of comprehensive information relating to a small economic area. Second, the uncertainty in forecasting future levels of economic growth must be minimized so that forecasting errors do not have large repercussion on capital budgetings.

The following forecasting technique was developed in connection with a plan for the development of a multimodal distribution center in a southwestern metropolis. The approach followed was to use national aggregate indicators or estimators of commodity flows for the particular metropolitan area as a beginning point and then to modify and refine the preliminary commodity-flow projections by a Bayesian statistical format that accounts for local or site-specific growth conditions and prospects.

NATIONAL AGGREGATE INDICATORS OF MODAL FLOW VOLUME, SHARE, AND SHIFT

The Maritime Administration (MARAD) has recently released a comprehensive study of nationwide modal commodity movements (2). A primary object of the study was to assemble a comprehensive transportation data base containing region-to-region flows of all commodities by surface transportation modes. Data on marine movements from the Corps of Engineers, rail movements from the Interstate Commerce Commission and the U.S. Department of Transportation, and truck movements from the U.S. Department of Commerce were used. Another object of the study was to forecast the future level of regional commodity flows by mode from the computerized data base. This report is the first such comprehensive transportation data base.

The data concerning historical trade flows by origin and destination were assembled in the MARAD report by economic regions as defined by the U.S. Department of Commerce Bureau of Economic Analysis (BEA). There are 173 BEA regions, nicknamed BEARs, in the United States. Each contains at least one major urban center and the surrounding counties that form its economic hinterland.

The trade flow data base of the MARAD report is arranged according to 19 commodity groupings. These groupings were selected on the basis of their importance to present and potential flow by the marine mode, and to provide homogeneous commodity groups as far as possible.

The MARAD projections for individual commodity groups were developed from multiple regression models in which the specific commodity flow in and out of each region (BEAR) by mode is the dependent or forecast variable. The independent variables are gross information on travel time, transportation costs, rate structures, and economic growth conditions for the origin and destination region.

A crucial point is relevant to the MARAD forecasts. In some cases, the predictive quality of the regression equations is limited, and the forecasts are made according to broad regions and are therefore not specific to the particular area under study. They are, however, together with a review and analysis of other sources of specific commodity potentials relevant to the study area, an excellent starting point from which to study commodity flows. The MARAD forecasts were thus used as unrefined predictors of the modal market share.

LOCAL ECONOMIC ANALYSIS AND REFINEMENT OF AGGREGATE COMMODITY FORECASTS

Economic growth forecasts cannot be made with 100 percent accuracy. However, a statistical distribution of possible alternative economic growth forecasts, each with an assigned percentage chance or probability of occurring, can be developed. Several different levels of economic growth forecasts, termed states, can thus be used to independently forecast future modal commodity flows, and the weighted average of the forecasts according to the various states (based on the percentage chance of occurrence of each state) represents the best fit, hedged projection against which to plan large, relatively inflexible investments.

Independent in-depth field interviews and analyses of the economic activity indicators of the local subregion were undertaken to develop alternative growth states specific to the hinterland of the particular port site. Among the proxies or indicators of economic activity and growth prospects considered were the following: population growth rates, industrial employment funds by Standard Industrial Classification and category corresponding to the classifications of the commodities used in the MARAD report, and personal income levels and trends.

Thus, in order to derive sound predictive, hedged commodity modal forecasts and to refine the MARAD projections for the specific localized economic conditions expected in this southwestern metropolitan area, four alternative possible states of economic growth were conceptualized for the metropolitan area for 1990. As described in the next section, the MARAD forecasts were adjusted and refined according to each of the states and a weighted average forecast was developed.

Figure 2 shows the four alternative economic growth rate states used (3) and the percentage chance of occurrence assigned to each state. Table 1 gives the final economic indicator criteria used to formulate and delineate these states and their forecasted percentage increases from 1970 to 1980 and 1980 to 1990.

FORMAL FORECASTING APPROACH

The formal forecasting approach is shown in Figure 3. This approach, which evolves from Bayesian statistics, involves adjusting and refining current estimates of modal commodity movements against the alternative future growth states of Figure 2. Each historical and projected MARAD commodity flow for the study area BEAR was reviewed independently. The quality of the predictive value of each commodity regression equation and the modal split was assessed, and adjusted commodity modal flow was developed and then arrayed for each alternative state of growth. These revised and refined forecasts over each state for each commodity were then recalculated to reflect the weighted average or hedged forecast. The final adjustments were made to distribute the flows among the various local river terminal systems. An example of a final output is shown in Table 2.

PLANNING IMPLEMENTATION AND FUNDING ISSUES

Because of the complex sunk-cost investment aspects and the need to plan investments on regionally sensitive fore-

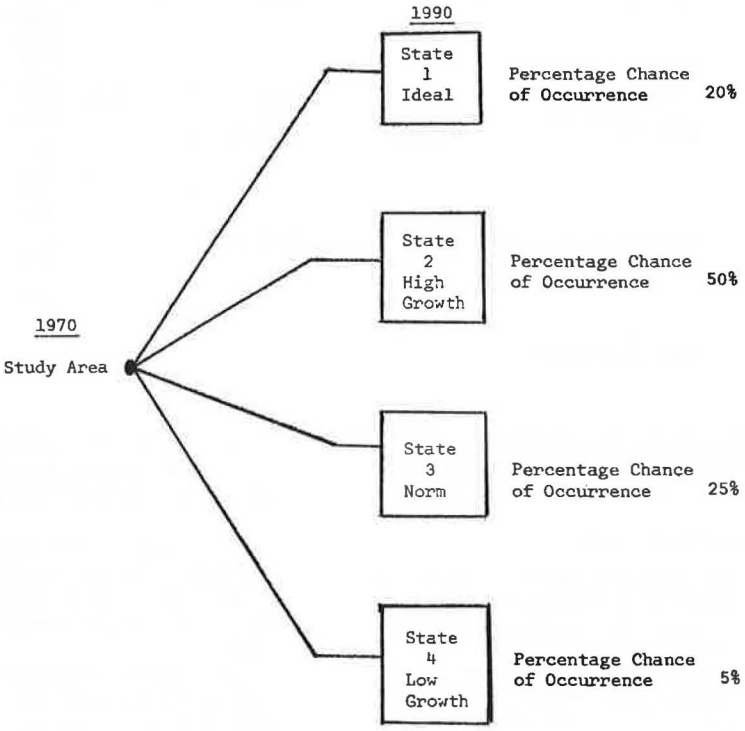

Figure 2. Alternative future economic growth states for a southwestern U.S. metropolitan study area.

Table 1. Criteria expressed as percentage increases used to delineate the state space.

	Population		Total Employment		Manufacturing Employment		Total Personal Income	
State	1970-1980	1980-1990	1970-1980	1980-1990	1970-1980	1980-1990	1970-1980	1980-1990
1	19	19	32	25	35	27	77	61
2	18	18	25	17	25	18	68	57
3	15	15	19	14	18	11	62	49
4	8	10	18	11	16	10	51	47

Figure 3. Formal forecasting approach.

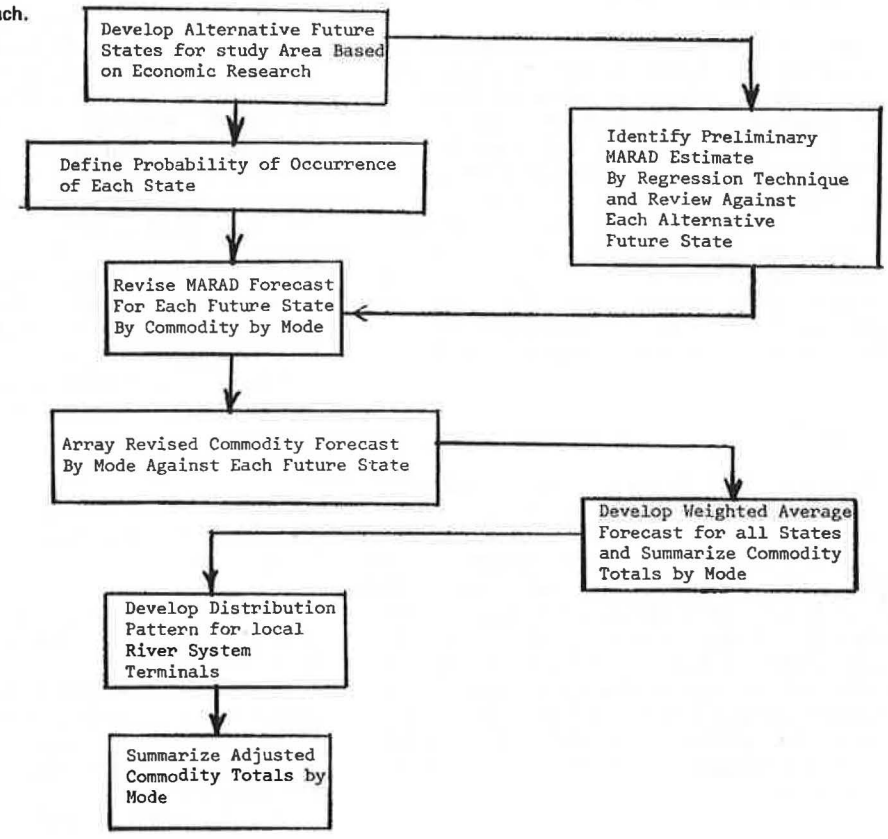

Table 2. Commodity modal forecast examples.

Commodity	Origin	Destination	Growth State	Adjusted MARAD Forecast (Gg)					
				Rail		Truck		Water	
				1980	1990	1980	1990	1980	1990
Chemicals	Houston	Little Rock	1	122	206	38	64	14	23
			2	110	185	34	57	12	20
			3	98	167	31	52	11	18
			4	89	150	27	46	9	16
			Avg	108	183	34	56	12	20
Primary iron and steel	New Orleans	Little Rock	1	153	250	—	—	17	28
			2	147	240	—	—	16	27
			3	128	209	—	—	15	24
			4	115	188	—	—	13	21
			Avg	142	232	—	—	16	26

Note: 1 Gg = 1102 tons.

casts, it is desirable to develop a more formalized implementation and funding capability for port planning. A concept for this is shown below.

Subprogram	Program Elements
Port proper facilities	Site-related (transit sheds, tank farms, and cranes), intermodal transfer, moorage
Private development stimulus	Taxing structure, utilities, zoning, private venture capital, land supply
Rail	Rates, line-haul facilities, yards
Highways	Interstate, urban system, urban high density, economic growth center program, local and site roads and parking, trucking rates
Mass transit	Demonstration technology, bus, rail

Port and port-related transportation and land use planning can be conceived as a program budgeting framework whose investment elements integrate across several subprograms. Three plausible general implementation and funding mechanisms are explored in this context.

Current Categorical Grant Approach

This, the current method of facility provision, uses the ongoing categorical grant approach, with programs administered by a state department of transportation or other relevant individual agency, coordinated through the A-95 format. The essence of this structure is that it uses current legislative structures subject to typical local matching requirements, and fits together modal components in a conventional way. It does not specifically address the question of funding, or defining as private or public, the specific port components such as moorage and terminal and cargo handling facilities, nor does it consider the integration of such funding with private sources of capital and local port-specific sources of income.

Port Arena Concept

An alternative to the conventional approach is that of the development of an intermodal package program, which identifies all intermodal transportation facility necessities of water, terminal, moorage, cargo handling, highway and parking, rail, and transit associated with the port and the port-related private capitalized land use. Such a spatial and facility identification conceptually creates a port arena of public and private facilities. In this concept, the public facilities can be funded as a block grant, termed an intermodal arena grant, and ultimately plausible mechanisms for guidelines for such a block grant program should be developed. Such guidelines should specifically consider

1. How to spatially define the area,
2. How to appropriate governmental levels of funding, i.e., state versus federal determination of local matching,
3. How to integrate land uses and port endeavors at the site and their contribution to matching,
4. How to institute the A-95 Unified Work Program as a viable intermodal planning and capital activity, and
5. How to determine the eligibility of specific port-related items such as moorage and cargo handling facilities for public funding.

Structured Joint Funding Programs (Integrated Grant Administration)

A third approach, proposed as a middle ground between categorical granting and site block grants, is the emerging joint funding simplification program, previously known as integrated grant administration. This concept was developed at the General Services Administration and is currently being moved to the Office of Management and Budget. It allows the use of funds eligible for project-related activities in cases in which inadequate planning might have voided such potentials. The recent demonstration programs of joint funding have been reasonably successful in combining the support of several agencies dealing with housing, land use, sanitation, and education under a single lead agency. It is possible to develop an implementation structure for a regional port by drawing on the several modal support options in the Department of Transportation, the U.S. Corps of Engineers, the Economic Development Administration qualified public project process, certain MARAD options, and revenue sharing and community development sources, in addition to other local sources. Port development could be structured within existing agency operations and typical public and private ownership mixes, and seemingly have adequate access to all available implementation funds.

CONCLUSIONS

The following conclusions as to the current status of port planning and its relation to multimodal planning processes are offered.

1. The port is an inherent multimodal entity whose activities parallel the transportation planning process in its entirety.
2. The development of forecasting tools that are regional and site-sensitive with respect to economic and growth states and an aggregate goods-movement modal-split analysis are needed. A preliminary approach to such is presented here.
3. There are several plausible approaches to port

planning implementation and funding. A study of their efficacy and their capability for integration with A-95 regional planning implementation activities and intermodal planning activities should be made.

4. Formal guidelines should be developed for port and intermodal planning and development and should be integrated into current regional transportation planning guidelines and processes.

5. Legislation appropriate to executing such guidelines and related forms and types of federal-state-local funding combinations should be written.

6. Formal recommendations as to the position of port and intermodal planning in national transportation planning perspectives and related national transportation policy statements should be developed.

Ports represent a sizable, fixed-capital investment requiring immense local force to develop. They yield significant benefits if successful, but vast waste and disillusionment if they are unsuccessful. It is in the interests of federal and local government and society at large to standardize their planning, funding, and implementation process to a degree more typical of, and integrated with, related transportation modes.

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