PRODUCTIVITY

And Capacity Of Container Terminals

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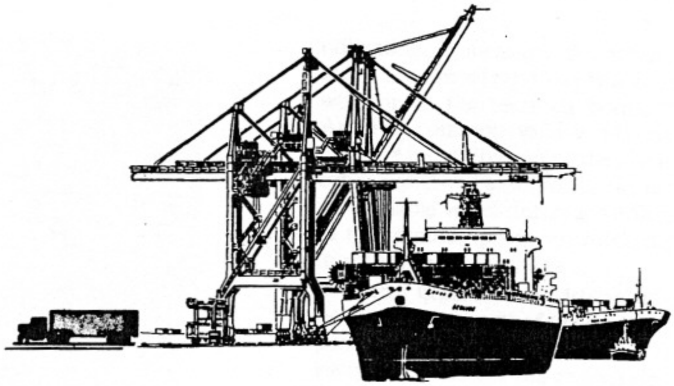

Many U.S. ports face the same problems of coping with the development of new facilities while the existing ones are not fully utilized. Since the subject is broad, Mr. Ashar has divided the paper into two, separate articles. The second will appear in the December/January 1986 edition of WWS/World Wide Shipping.

The ocean liner transportation industry has undergone revolutionary changes in recent years. Mammoth 4500 TEU vessels, oversize 45' (or 48') by 9'6" non-ISO boxes, round-the-world services, integrated intermodal ocean and land transportation controlled by shipping lines, double-stack trains crossing the continent, a new Shipping Act resulting in new multi-national consortiums and new super-conferences—all seem to follow one after the other at an accelerating pace.

Nothing revolutionary, however, has occured in the container port industry in recent years. Ship operation is performed by almost the same gantry shore cranes that were introduced 25 years ago. Although the cranes grew in dimensions to accommodate the new large vessels, their major characteristic—productivity—remained basically the same. Likewise, no real changes were recorded in yard operation. The same 3 basic methods which were introduced at the inception of containerization—the chassis, straddle carrier/toplift and yard crane—still command the yards. Matson's innovative "mouse trap", ECT's twin-trolley crane and container train, Mitsubishi's Traverse system—all these innovations left the industry indifferent.

The only real change recorded in the U.S. port industry was the immense expansion in ports' physical size. Following the general growth in international trade, magnified by the load-centering trends, major U.S. ports enjoyed a fast increase in their traffic. Two ports (New York and Seattle) have already crossed the "symbolic" 1 million TEU per year traffic and at least 5 others are approaching this benchmark.

The fast growth in traffic induced a massive growth in facilities; it did not, however, induce a parallel increase in terminal productivity. American President Lines' new terminal in Los Angeles (110 acres with option for 20 additional acres), and Sea-Land's new Tacoma terminal (90 acres in the future) are mere blown-up versions of existing terminals with no evident novelties that might lead to improved productivity. In developing this type of large terminals ports became the major consumers of waterfront area; vast, expensive-to-develop waterfront areas in scarce supply are used as parking lots for containers.

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It seems that this lavish development path of U.S. ports stems from structural factors: the innovative shipping lines are privately-held enterprises, operating in the recently de-regulated market; ports are public, quasi-governmental, regional agencies. Public ports are the sole providers of terminals, but they have no say as to how these terminals are utilized. Moreover, public ports compete against other public ports. Providing more terminals at cheaper, highly-subsidized rates is the only way for ports to survive in this mixed, public-competitive, environment.

In order to cope responsibly with wasteful situation this author of these articles suggests that:

1) Ports should be involved in terminal operation especially relative to productive usage of terminal facilities; and

2) Ports should make a careful, in-depth analysis of their terminal capacity before devoting public moneys for development of new terminals.

Continuous involvement in terminal productivity and capacity issues requires development of an appropriate system in which terminal operation data is continuously collated, analysed and evaluated. This series of articles will introduce a *Terminal Management System* that was developed and applied at the Port of Seattle. The first article will discuss productivity issues; the second will focus on capacity and expansion of container ports.

Terminal Indicators System

Terminal Area Survey

The first stage in establishing the Terminal Management System is to conduct a functional survey of the port terminals. Each terminal area is divided according to the main terminal elements: berthage, container yard, CFS, gates, offices, parking, maintenance shop and others. The actual measurement of the different terminal components can be done according to facilities drawings, updated area photos and terminal layouts. It is recommended that the survey will be conducted in close consultation with terminal operators. The terminal survey findings should be kept updated following changes in terminal areas and operation systems.

Table 1 includes a sample of recent survey of Seattle terminals.

Vessel Operation Reports

The best source of operational data is the Vessel Operation Reports (VOR) prepared by the terminal operators for the shipping lines (and for other parties). There are, however, two problems associated with these reports: 1) VORs are confidential, they contain accurate data which expose both the line and the terminal operator; and 2) each line and each operator has a slightly different method of preparing VOR. The Port must first insure strict confidentially of the collated data, and then analyse a sample of VORs and develop a common way of measuring and recording operational data.

The VORs should be received by Port immediately after their preparation and any problems should be resolved in a timely manner. It is desirable, at least for large ports, that the collection and analysis of operational data from the VORs is done through a computerized system (any database software for micro-computers can handle it easily). It is also important to assure that the person in charge of the system is familiar with terminal procedures.

Table 1. Terminal Area Survey *

Function	Description	TEU	sq ft	acres	%
Gates					
Inbound	8 lanes (4 scales)	—	75,000		
Outbound	6 lanes	—	49,000		
Administrative Bld		—	3,000		
	Subtotal		127,000	2.92	6.5%
Apron & Berthage	**1210', 2 cranes**	**—**	**122,000**	**2.80**	**6.3%**
Container Yard					
Stacked-Transtainer		1206	332,000		
Empty-Toplift		598	124.000		
Chassis		677	122,000		
Stacked Chassis		—	170,000		
Circulation		—	342,000		
	Subtotal		1,090,000	25.02	56.1%
Terminal Buildings	**Yard Offices**	**—**	**1,850**	**0.04**	**0.1%**
Maintenance Area					
Buildings		—	3,300		
Container & Chassis Parking		234	52,000		
Circulation		—	67,000		
	Subtotal		122,300	2.81	6.3%
CFS Area					
Buildings		—	98,000		
Container & Chassis Parking		354	123,000		
Circulation Area		—	192,000		
	Subtotal		413,000	9.48	21.3%
Parking Area		—	66,000	1.52	
Total		**3069**	**1,942,150**	**44.59**	**100.0%**

** Based on sample data*

Productivity Indicators

Analysis of operational data can be done through a system of indicators. Many productivity measures (or indicators) have been suggested in the professional literature. Each port can select measures it considers meaningful according to its terminal management goals. I suggest to concentrate on 5 basic measures dealing with the usage of the major components of a container terminal. The suggested indicators can be calculated on a monthly or quarterly basis.

1). TEUs per Total Terminal Acre

This indicator measures the general productivity of the waterfront area occupied by the terminal. The suggested measurement for terminal production is the total TEU-equivalent of all containers, loaded or empty, exchanged by vessels calling at the terminal (excluding re-handles). The indicator results vary depending on terminal layout, yard system, cargo type (bridge vs. local), gate hours (especially nights opening) and many others.

2). TEUs per Container Yard Acre

This indicator relates to the utilization of the largest area component in the container terminal. The suggested definition of container yard is the open area adjacent to the berthage, employed directly for storage of boxes (and chassis) and for movement of yard machines associated with vessel loading/discharge.

As will be shown later in the Capacity article, this measure is, in most cases, the major determinant of terminal capacity.

3). Vessel-Shifts per Berth

The berth is the second most costly terminal component, especially if investment in navigable access is added to the investment in apron. The suggested indicator is a very useful indicator to describe berth utilization. It measures the actual, active time in which there is a ship working at the terminal berth(s). Another common version of this measure is the division of the number of vessel-shifts worked by the total available vessel-shifts (according to the terminal practices) resulting in utilization percentage.

Berth utilization is also an important determinant of terminal capacity. The measure varies with service type (moves per call and service frequency), number of available cranes at berth, crane productivity and operation practices (working night shifts, especially).

4). Moves per Crane

Here we measure the production of the major piece of equipment on the container terminal. Moves include all boxes handled from/to vessels, including re-handles but not shiftings of boxes directly between hatches (not across the apron).

5). Moves per Crane-Hour

This is a well-known indicator concerned mainly with labor productivity. The common way of calculating crane productivity refers either to actual working hours (net productivity) or to available hours (gross productivity).

Other possible indicators (not discussed here) are:

Area Measures - sub-division of the above-mentioned area measures according to cargo direction (in/out), storage system (ground/stack), type (empty/loaded, reefer, chassis).

Berth Measures—TEUs or Moves per Berth, TEUs or Moves per Ship-Hour of stay, Ship Calls per Berth, Ship-Shifts per Ship-Call, Shifts between Ship-Calls (inter-arrival time).

Crane Measures - TEUs per Crane, Gross or Net Crane-Hours divided by Available Hours, Crane-Shifts per Ship-Calls.

Other Measures - Gate Moves per Vessel-Moves, Gate-Moves per Gate-Lanes, Container Dwell-Time (days), TEUs or Moves per Ship-Call, Empty to Loaded ratio, TEU per move, Revenue-Tonnes per TEU.

Table 2. Container Terminals Productivity Profile

Terminal Data					Operation Data *(quarterly)*				Productivity Indicators *(annually)*			
Terminal #	**Terminal Acre**	**Yard Acre**	**Berths**	**Cranes**	**Vessel Calls**	**Vessel Moves**	**Vessel TEUs**	**Vessel Shifts**	**TEUs per Tot. Acre**	**TEUs per Yard Acre**	**Ves. Shifts per Berth**	**Moves per Crane**
T-5	65	36	2	4	51	59,167	106,500	238	4,915	8,875	476	59,167
T-18	82	63	5	6	87	45,829	80,200	317	2,934	3,819	254	30,552
T-25	24	10	2	2	12	5,905	10,924	34	1,366	3,277	69	11,810
T-37	44	32	1	2	27	19,796	32,664	96	2,227	3,062	383	39,593
T-46	45	37	2	3	33	25,021	47,540	97	3,169	3,855	194	33,361
Average									**3,206**	**4,682**	**261**	**36,639**
Total	**260**	**178**	**12**	**17**	**210**	**155,718**	**277,828**	**782**				

**Sample, based on past data.*

Productivity Profile

The Productivity Indicators, when carefully calculated over a sufficient length of time (at least one year) and charted on a special form, depict a Productivity Profile for each terminal. Accordingly, consolidating the data for all the port terminals creates a profile of the entire port.

Analysis of the Productivity Indicator data can be performed by looking at the time series trends of each indicator and trying to correlate them with the various events on the terminal. Comparing results among the various port terminals, assuming some similarity exists between these terminals, also provides a useful analysis tool.

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Comparisons can be conducted between different ports as well (if similar data are available). It is suggested that the analysis be done on a quarterly basis using charts and other illustrative device.

The quarterly report can be sent to the terminal operators for review containing only general data due to confidentiality, can be discussed in a periodical, joint port-terminal operators meeting. It is important to demonstrate to the terminal users that the Port put a special emphasis on the productivity issues.

Table 2 presents selected past data on the performance of Seattle terminals.

Fig 1. Area Productivity Indicators (POS Terminals)

Year	TEU/ Yard-Acre	TEU/ Total Acre
1980	4,307	2,859
1981	3,676	2,517
1982	3,708	2,539
1983	4,398	3,025
1984	4,884	3,395
1985*	4,753	3,304

* *Estimated equivalent*

Figure 1 shows the development in TEUs per Total Acre and TEU per Yard Acre (1980-1985).

In summary, ports should change their role of being "passive" landlords. Public ports should closely follow the operation of their container facilities. They must make sure that public moneys invested in these terminals are effectively utilized and unnecessary expansion avoided. For this purpose, the author suggests that each port should establish a special management tool, namely the Terminal Management System.

The next article to follow in this series will deal with another, related management tool. It will introduce a methodology for calculating of terminal capacity and planning for future expansion of terminals. □