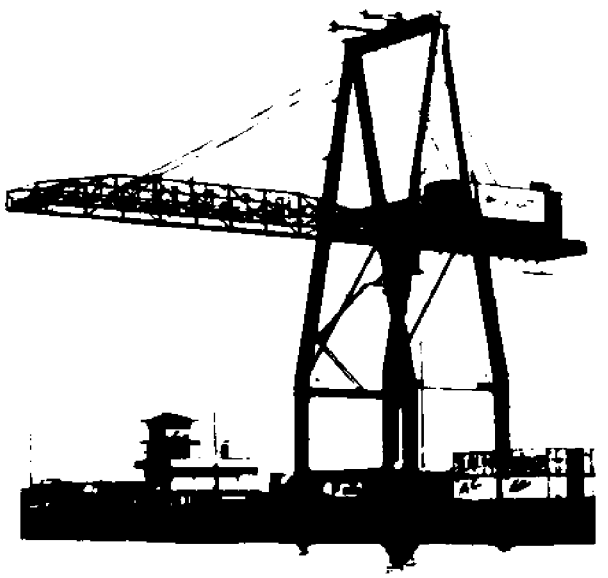
Container Terminal Productivity: A Perspective

PORT MANAGEMENT SERIES



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Introduction

"Productivity is important, but in perspective!"[1]

This paper provides a perspective on container terminal productivity—how it is measured, the validity of the measurements used, and the factors that affect the elements of productivity.

The tremendous capital outlays, coupled with the demands of shippers for faster, cheaper delivery of cargo, brought about increasing pressure for improved productivity and this led the National Association of Stevedores in April 1984 to ask the Maritime Administration (MARAD) to undertake a study of United States marine container terminal productivity. MARAD contracted with the Marine Board of the National Research Council (NRC) to undertake the study, which culminated in a report ("Improving Productivity in U.S. Marine Container Terminals") issued in the summer of 1986.[2]

The Sea Grant research project described in this paper was designed to explore the problems and prospects of using the container terminal productivity measurements identified in the NRC/MARAD study.[3] The cooperation of a multitude of U.S. and Canadian terminal operators, labor organizations, carriers, port authorities, shippers, the American Association of Port Authorities, and the National Association

[1]Robert Nolan, International Terminal Operating Co., Inc., New York, January 1986.

[2]1987 Annual Report--Pacific Maritime Association.

[3]National Academy Press, 1986 Improving Productivity in U.S. Marine Container Terminals, Washington, D.C.

of Stevedores in the research for this Washington Sea Grant funded project is gratefully acknowledged.

Containerization

Containerization, the movement of cargo in containers, is a System. It has an ocean component and a land component.

It is a dynamic System within which the players (carriers, terminal operators, stevedores, labor, port authorities, shippers, railroads, truckers, government, and others) all interact. Each exerts influence over productivity and at one time or another may be the primary determinant or constraint on control of productivity at a specific terminal or within the entire System. As new players come into this System, the balance of power shifts. For instance when stack car unit trains came onto the scene, railroad operating requirements and scheduling caused significant changes, and railroads became a principal player in the System.

A major problem that faces the System is that each player reacts according to his own self-interests or what he perceives his best interests to be at any given moment--often with little or no concern for the System or, more exactly, for the efficiency of the System. In recent times with the advent of the logistically oriented carrier (e.g. American President Companies, CSX-Sea Land), the effect of this diffusion of self-interests has been lessened because a single organization controls a number of segments within the System.

Whenever someone looks at the Containerization System, there is an assumption that if the terminal works at its maximum efficiency, then the entire System benefits. According to our observations, it appears that maximizing terminal efficiency might only shift the bottlenecks to some other element within the System. For example, if terminal efficiency were increased to a point where all intermodal import containers were processed in half the current time, the real value of this increased terminal efficiency would depend on whether the intermodal transfer facility could accommodate the increased volume. In effect, the real value of an increase in terminal efficiency depends on whether it increases the efficiency of the entire System or simply creates bottlenecks in some other element of the System.

From the standpoint of terminal productivity, each player has his own self-interests. For the terminal operator, the main goal may be to reduce or stabilize the cost per container handled and thus maximize per unit profit; for the port authority, the main goal may be to increase the annual throughput per acre of its leased terminals and thus avoid having to build new facilities until all current facilities are fully/efficiently utilized; for labor the main goal may be to increase union jobs and total cargo handled by its members; and for the carrier, the main goal may be to minimize ship in-port time and/or facilitate the expeditious handling of all loads, especially "hot" containers. All these are laudable, but often conflicting, goals. It is within this arena of conflicting self-interests (goals) that container terminal productivity exists.

Quite often the terminal operator (a term that includes the stevedoring subsidiary of a carrier) is caught in the middle of this arena of conflict. To complicate this matter still further, the terminal operator's performance is normally judged by productivity measurements that are heavily dependent on factors over which he has limited or no control.

Container Terminal

A container terminal is a facility that provides a package of activities/services to handle and control container flows from vessel to railroad, or road, and vice versa.[4] The container terminal is the physical link between ocean and land modes of transport and a major component of the Containerization System.

Productivity

Container terminal productivity deals with the efficient use of labor, equipment, and land. Terminal productivity measurement is a means to quantify the efficiency of the use of these three resources.

[4]Liberally drawn from the remarks of Joan Rijsenbrij, Europe Container Terminus, Rotterdam, January 1986.

Limiting Factors

For every container terminal, there are limits as to how productive that terminal can be. These limits may be imposed by either physical or institutional factors, or a combination of both.

Physical limiting factors are such things as the area, shape, and layout of the terminal itself, the amount and type of equipment available, and the type and characteristics of the vessels using the terminal. For example, our observations suggest that productivity (moves per gang hour) is definitely affected by vessel type/characteristics. A vessel or vessel class that the terminal operator has experience with can usually be discharged and/or loaded more efficiently than one that is on its initial call to a terminal, or one that calls infrequently.

Of course there are more obvious physical limiting factors, such as a terminal that is run as an on-chassis or wheeled operation that lacks sufficient chassis. This causes the operator to "ground" containers in order to have sufficient chassis to put against the ship when it arrives—an action that obviously limits the productivity of the container yard.

Lack of cranes, insufficient land, odd-shaped container yards, inadequate berthage, inadequate gate facilities, and difficult road access are all physical limiting factors.

Institutional limiting factors are more difficult to define than physical limiting factors. Institutional factors may be imposed on a terminal operator by any of the players in the Containerization System. Institutional factors are such things as union workrules, import/export mix, container size mix, container availability, stow of arriving vessels, customs regulations, intermodal train scheduling, safety rules, and last, but far from least, requirements imposed on the terminal operator by the carrier.

If there was one area whose effect on productivity we had initially underestimated, it was these institutional factors. Our research indicates that these institutional factors, especially the requirements of carriers imposed on the terminal operator, often have effects equal to, or exceeding those of, the physical factors.

For example, a carrier may require that the terminal operator accept containers at any time before the ship sails. This causes the operator to have to make provisions for late-arriving containers such as last minute adjustments to the stow plan. Some foreign terminals that have exceptionally high productivity are able to limit delivery of containers to the terminal as much as 24 hours prior to the ship's arrival. This allows for more efficient preplanning of the terminal, and vessel loading and stowage. Another example of the carrier limiting terminal productivity is a requirement to expedite lifting off specific containers ("hot boxes") as soon as possible after the ship arrives. Such a requirement forces the terminal operator to establish initial crane placements to coincide with the locations of these "hot boxes." Normally, these containers are not block stowed, but are located in several places on the vessel—some on deck and some below deck. Only after these "hot boxes" are lifted off can a more efficient systematic crane placement schedule be undertaken.

Another example of an institutional limiting factor would be a union workrule that requires the entire gang to take coffee breaks and/or meal breaks as a group or at a specific time rather than allowing such breaks to be taken individually while work continues.

If a carrier allows its customer, without penalty, to deliver export containers to the terminal far in advance of ship arrival, or to leave import containers on the terminal long after the ship sails, thus increasing the terminal dwell time, this creates an institutional limiting factor.

Perspective?

In many instances, these institutional and physical limiting factors can be mitigated or eliminated. However, it usually requires an increase in cost, or a rearrangement of priorities to do that. For example, if a labor workrule that limits productivity is amended or abolished, it may require an increase in manning, or in the compensation of the existing gang. There must be some consideration on the part of the carrier and/or operator as to the value of eliminating or amending that specific workrule versus the cost in money or adjusted priorities and its ultimate effect on the System.

The same is true for equipment. It may be possible to increase productivity by adding another piece of equipment, or by replacing a serviceable piece of equipment with a newer,

more efficient model. But a decision to do so requires that someone (carrier and/or operator) must determine that such action is worth the added cost in dollars, or in an adjustment of priorities, and that such an action would benefit the System. It is in this context that one truly appreciates the meaning of the statement "Productivity is important, but in perspective."

PRODUCTIVITY MEASUREMENTS AND FACTORS AFFECTING CONTAINER TERMINAL PRODUCTIVITY

Terminal operations elements	Important factors influencing productivity	Nature of influence on operations	Productivity measure	Productivity factor measured
Container Yard	Area,shape,layout Yard handling methodology Box size mix Dwell time	Extent to which containers must be grounded, stacked (inc. chassis)	TEUs/yr/gross acre TEUs capacity/net storage area	Yard Throughput Yard Storage
Crane	Crane characteristics Level of operator skill,training Availability of cargo Breakdowns Breaks in yard support Vessel characteristics	Operational delays	Moves/gross gang or crane hours - down time Moves/gross gang or crane hours	Net Productivity Gross Productivity
Gate	Hours of operation Number of lanes Degree of automation Availability of data	Extent to which weighing, inspection documentation checks are expedited	Containers/hours/lane Equipment moves/hour/lane Truck turnaround time	Net Throughput Gross Throughput
Berth	Vessel scheduling Berth length Number of cranes	Extent of berth utilization	Container vessel shifts worked/yr/container berth	Net Utilization
Labor	Gang size Work & Safety rules Workforce skill, training,motivation Vessel characteristics	General tempo speed of operations	Number of moves/man hour	Gross Labor Productivity

Measuring Productivity

These physical and institutional limiting factors, when placed in the context of a component in a formula to measure terminal productivity, become variables. As such, these factors or variables influence productivity measurement and make it difficult (if not impossible) to strictly compare any two or more terminals, or establish valid standards for terminal productivity.

In addition to these limiting factors, there is yet another variable that affects the measurement of terminal productivity—semantics!

On the basis of our research, it appears that the measurement of container terminal productivity bears more relationship to an art form than to a science! The lack of uniformity in the data used in productivity formulas is enormous. For example, some terminals count rehandles and hatchcovers as "moves,"whereas others do not. This lack of uniformity in the definition of the elements of the various formulas used to measure terminal productivity makes it very difficult validly to compare productivity data of one terminal to that of another terminal or to establish any valid standards of productivity for international, national, regional, or portwide application.

Productivity Standards?

Perhaps the most important single finding of this project is that it appears inadvisable to establish "standards" or "averages" for terminal productivity on an international, national, or portwide basis. Almost since the advent of containerization, there has been support for the establishment of universal standards for terminal productivity. For example, ports supported this effort in order to have a benchmark that showed clearly that their facilities, whether operated by the port itself or by a terminal operator, were "efficient."

A related subject that has also gained some support is the use of cross-sectional analysis of productivity—comparing the productivity of one terminal with that of another terminal, or the productivity of one port's terminals with those of another port. This is usually done to claim a terminal's or a port's productivity superiority over its rival terminal or port. This project has also led to a finding that there is no universally valid way to compare productivity on a cross-sectional analysis basis. Such comparisons must be made carefully, and on a case-by-case basis. In many cases, it is more appropriate to compare productivity on a time-series basis, comparing productivity at a single terminal over two or more time periods.

Thus, when one attempts to quantify a single terminal's or port's productivity in order to compare it with that of another port or terminal, problems immediately arise! The same is true when one attempts to use this same methodology to set standards of productivity or to compute some form of industry or portwide average productivity.

Conclusions

To obtain the maximum value from productivity data, a terminal operator must link cost data with them. By linking the cost and productivity data, it is possible to form one or a series of profit centers that allow the terminal operator to truly manage the terminal.

If managing productivity is viewed as a process of shifting existing constraints on productivity from one area to another, then cost information can usefully guide these constraints to an area or areas that minimize the impact of these productivity constraints on overall cost.

On several occasions, we were informed that a terminal operator had made a concerted effort to improve productivity in a specific activity only to have that effort halted when expenses increased drastically. Yet only a very few terminals, mainly the larger carrier-operated terminals, have a sophisticated cost accounting system linked to productivity data.

We have found a number of projects to increase terminal productivity tied directly to increasing the efficiency of the intermodal activities. Thus, it would appear that for many carriers the intermodal activities are the driving force for increases in container terminal productivity. This is an indication that a Systems approach is being taken by the more progressive carriers and that productivity of container terminals is being considered within a System perspective.

Container terminal productivity is an important topic, but it must be considered in a System's perspective in order for it to be of maximum value to industry.

A forthcoming report will discuss a quantitative analysis of container terminal productivity at several terminals.

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