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Along Selected Transit Corridors and on
Transport Performance Indicators

MEASURING PORT PERFORMANCE AND PRODUCTION

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MEASURING PORT PERFORMANCE AND PRODUCTION

I. BACKGROUND

1. During the past three decades there have been dramatic changes in the technology of shipping and in the associated technologies of ports. Substantial capital expenditures on vessels have been accompanied by large investments in ports. Unlike ocean shipping, the ports in developing countries, especially those in Africa, are usually owned by governments; thus the cost of these large investments is part of government development programmes. The surpluses or deficits of port authorities, therefore become part of government's budget, so the the financial health of a port is always a matter of general concern to governments.

2. Since ports are the intermediaries between ships and domestic transport networks, they take on some of the technological and economic complexions of their customers. The size of a ship and the time spent in port are important factors in determining the cost per ton of shipping. Also the depth of the dredged channel and the speed of loading and discharging cargo are usually dominant elements in the cost of ports. These relations are at the heart of much shipping and port economics. It is possible to determine them accurately only if efforts are made by port authorities in Africa to modernize and harmonize the relevant port statistics as a basis for the introduction of performance indicators which can be utilized to accurately measure port performance and productivity.

3. Extensive work, funded by UNDP has been carried out by UNCTAD in association with ECA and in collaboration with the Port Management Associations of both Western and Eastern Africa in the modernization and harmonization of port statistics and introduction of performance indicators. This took place in the late 70's and early 80's and a manual was prepared by UNCTAD to give guidance to enable port authorities to prepare uniform statistical information and to present common performance indicators. One of the basic objectives of the project was to provide operational information for port managers to allow them to monitor the performance in the port and thus identify problem areas and take steps to improve operations. The degree of implementation of the project varied a great deal in the two regions. The main obstacles being either lack of resources or the trend towards the separation of the cargo handling and statistical functions between different organizations in the various ports.

4. Today, some users in Africa have a choice in their selection of a port, and port authorities must be able to prove to them the advantage of their port in user port performance and productivity terms. Port users look at a port in terms of direct port charges and time costs. The factors to be considered are ocean freight rates, ship related charges, cargo related charges, cargo handling charges, cargo storage and transfer charges, inland transport charges and finally the total transport time. Thus port users consider port performance in financial terms for the evaluation of their quality and efficiency of services. Port authorities must, therefore, take steps to collect the relevant cost information which will be essential for their marketing effort.

5. After the conclusion of the first United Nations Transport and Communications Decade for Africa (UNTACDA II), it was realized that the shortage of data for planning, efficiency monitoring and forecasting emerging transport problems was a major concern for the development and monitoring the performance of all modes of transport including ports. Under the joint ECA/World Bank project on Sub-saharan Africa Transport Programme (SSATP) a study was launched in 1992 to provide guidance on the development and upkeep of a transport information system covering all transport modes. A closing seminar for phase one of the programme conducted in 1994 recommended that ECA should prepare a consolidated report on performance indicators covering all modes of transport. In the field of ports, the seminar reviewed and approved a set of performance indicators to be used for measuring performance in the ports subsector.

6. The set of indicators for ports which were approved under the UNTACDA II for inclusion in the regional transport data base programme is attached herewith as annex I. The methodology for their calculation was discussed during the closing seminar for phase I of the transport data base programme and agreed upon as follows:

1. The port operations performance indicator on <u>gross berth occupancy</u> should be calculated on an hourly basis

2. The performance indicator on <u>average tons loaded/unloaded</u> in berth per day should be dis-aggregated by type of vessel.

3. The unit for the indicator on <u>handling performance per working hour</u> should be expressed in tons/man/hour instead of tons/gang/hour.

4. <u>Tonnage handled per linear meter of quay</u> should no longer be considered as a performance indicator and should, therefore be excluded from the list of port operations performance indicators.

5. Handling performance for containers which is expressed in TEU/Crane/Hour should also be related also to the gangs.

6. Equipment availability should be calculated in a dis-aggregated manner.

7. With the advent of ~~privatization~~ in ports it is recommended that as part of the contractual obligations of the private companies they are required to supply the port authority periodically with performance indicators and availability figures for all facets of their operations.

II. ASSESSMENT OF THE UTILIZATION OF A PORT FACILITY

(a) Maximizing the use of existing port infrastructure

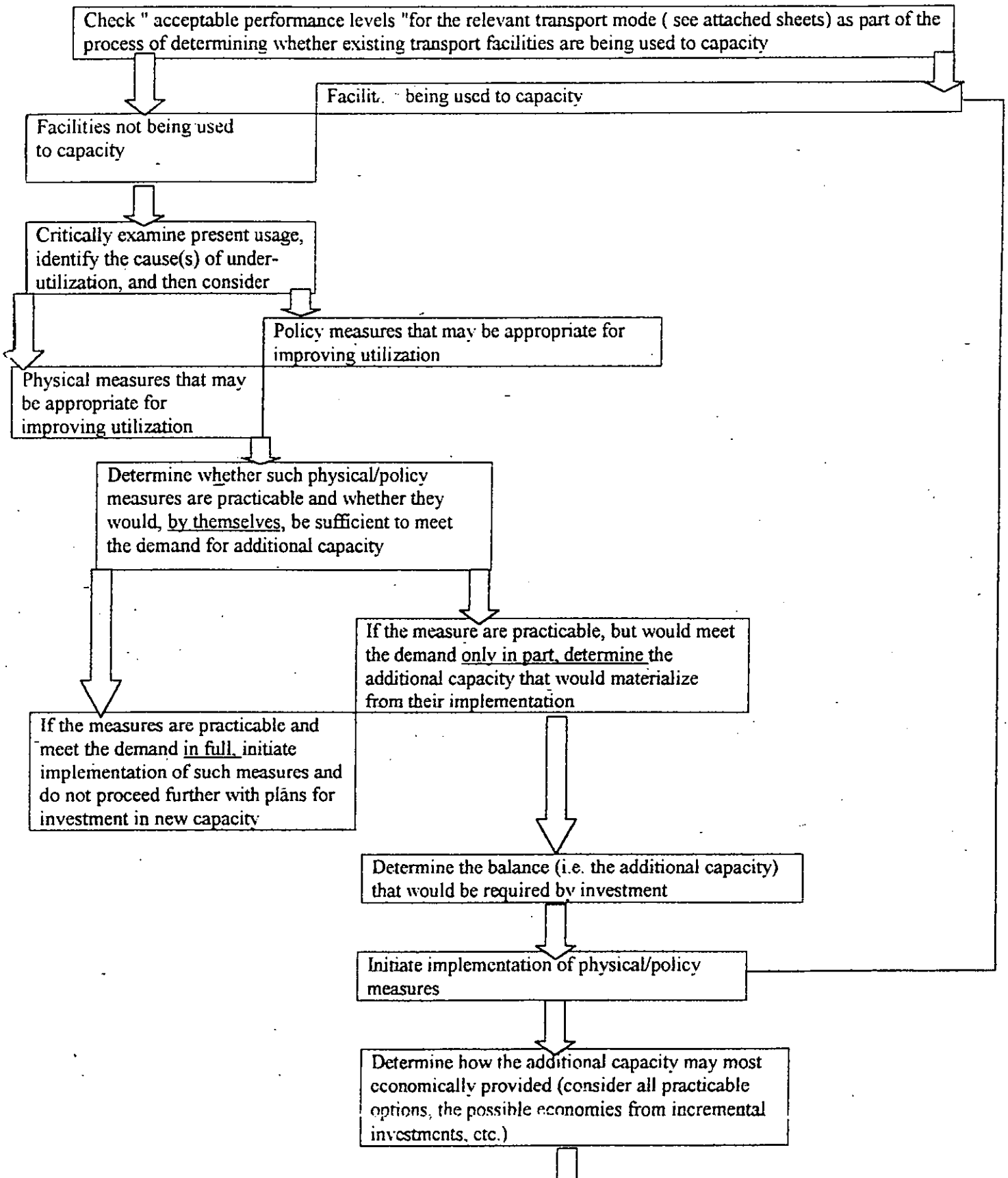
7. When assessing the utilization of a port facility eg. container terminal, all relevant indicators should be taken into account - and any single indicator by itself. When physical/policy measures to improve utilization are appropriate and practicable, and are implemented, the values of the indicators should begin to move in a favourable direction and it is the trend that is important. It would obviously be unrealistic to expect that all indicators would immediately jump to an acceptable level.

8. Examination of the appropriate "acceptable performance levels" may indicate that a berth is not being used to capacity but it will not indicate why . It would be the responsibility of the appropriate official (port planner, economist, operator, etc.) to diagnose correctly the results, for the shortfall in performance. A correct diagnosis is crucial if the "problem" is not correctly defined, the "remedy" will not be appropriate.

9. A particularly careful diagnosis is necessary when dealing with ports. The efficiency of a port may depend on many factors - the ships themselves, the berthing arrangements, the handling equipment, customs procedures, the efficiency of the road and rail links to and from the port area, etc. The greater the number of factors, the more ~~different~~ complex the diagnosis of the problem. Yet the diagnosis must be made, and correctly, if the appropriate physical and policy measures are to be predicted.

10. A simple "decision" Diagram 1 indicating the steps that should normally be followed when analyzing a proposal for expanding a port facility i.e. a container terminals given below.

Diagram 1
Maximizing the use of Transport Infrasturcture
—> Suggested Procedure for Examining an Investment Proposal

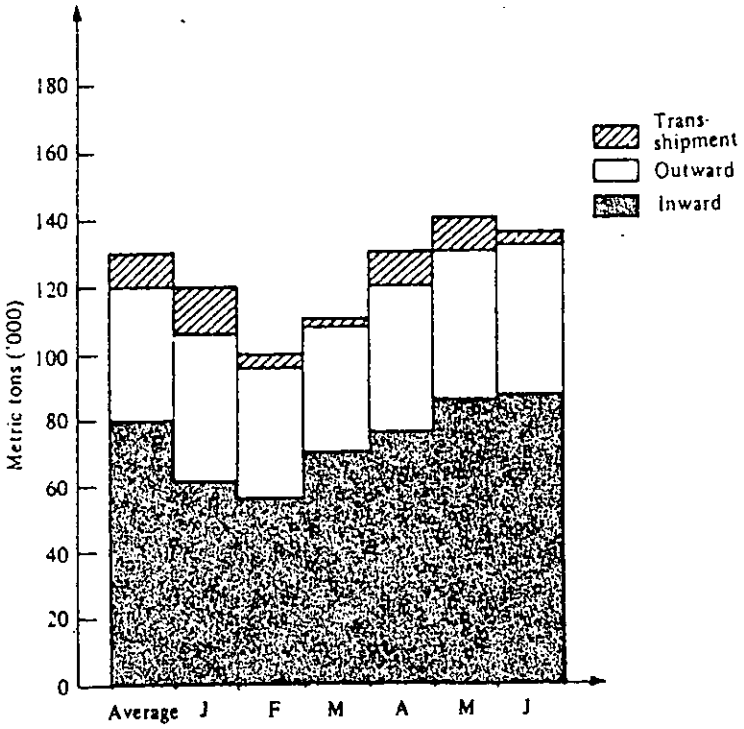


(b) The need for measures of performance

11. Port traffic is composed of inward, outward and transhipment cargo normally expressed in metric tonnes as illustrated in figure 1 below:

Figure 1

PORT TRAFFIC



Source: UNCTAD Monograph on Port Management.

12. Port management need to know whether the service they are giving to their customers, and the way in which they are using their facilities to provide it, is improving or deteriorating; they can then adjust their operating policies accordingly. Port planners need to know whether there are trends which necessitate a change in the quality of berth facilities. Expert advisers need to be able to make valid comparisons with other ports with which they are familiar so that they can identify policies and practices which are in need of improvement.

13. All these different needs can be met by means of analyzing performance indicators. There should be a careful selection of indicators, because a port is a complex organization and its performance cannot be judged by one or two figures only; thus a complete set of indicators will be needed. It will be better if the same indicators can be used for all the purposes described, but there will be differences of emphasis, and the manager, the planner and the advisor should be able to select from a full list the particular indicators that each finds more useful.

14. There are so many points to watch that it is not possible to judge the programme by looking at everything in detail. **There must be first, a smaller set of primary indicators, which allow a broad judgement to be made and points of serious deviation to be noted. These points can then be examined in greater detail to find the causes of deviations, by examining a further set of secondary indicators. The primary and secondary indicators will be arithmetically related and based on the same source of data.**

(c) Measuring port performance and productivity

15. Ports are essentially providers of service activities, in particular for vessels, cargo and inland transport and users (clearing agents, freight forwarders etc.). The degree of satisfaction that is obtained on the basis of pre-set standards price indicate the level of port performance achieved. From the foregoing, it is already obvious that port performance level will be different depending on whether ships, cargoes or inland transport vessels are served. Thus a port, at least in theory, may offer a very satisfactory service to vessel operators and at the same time be judged inadequate by cargo interests or inland transport operators (or vice versa). It is more likely that poor performance will not be limited to one group of port users, but rather pervade all services offered by the port. The important lesson to learn from this is that port performance cannot be assessed on the basis of a single value of measure. In fact a meaningful evaluation of a port's performance will require sets of measures relating to:

- The duration of a ship's stay in port
- The quality of the cargo handling
- The quality of service to inland transport vehicles during their passage through the port.

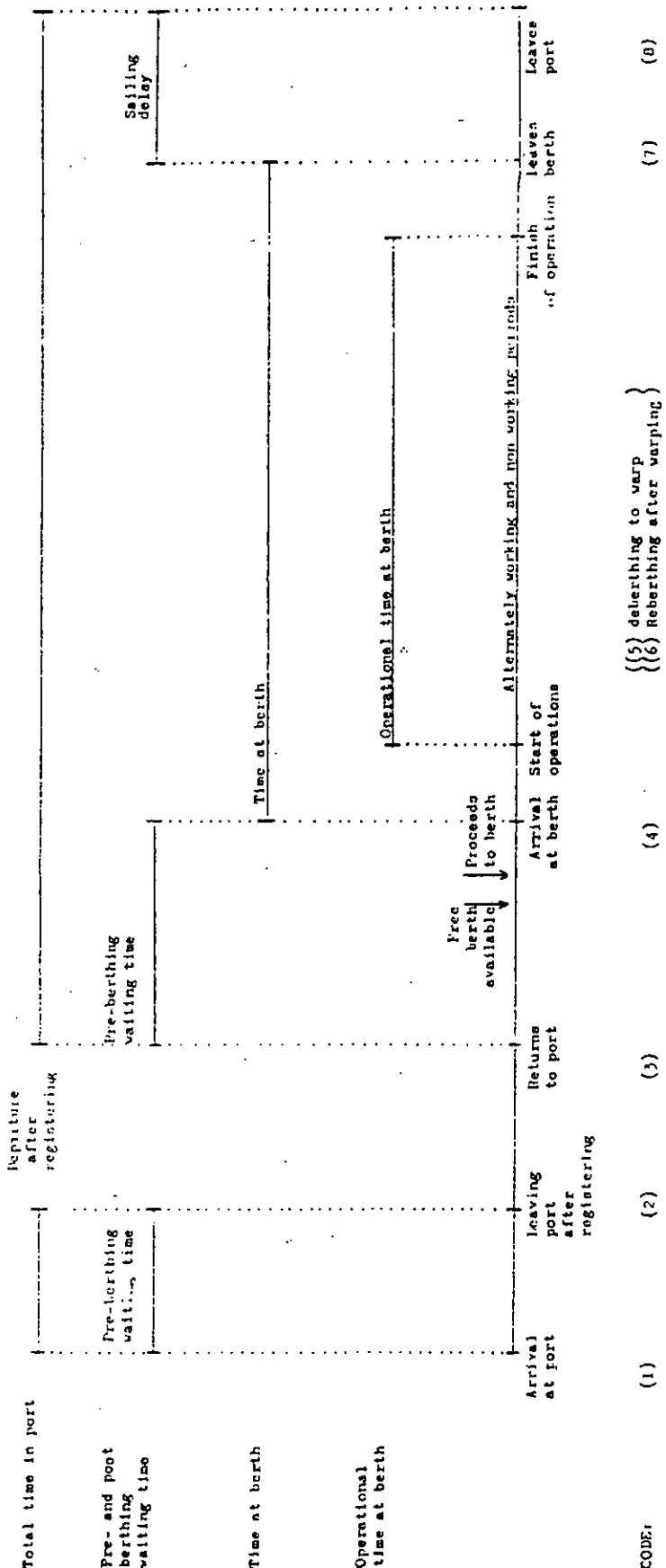
16. The complicating factor is the strong interrelationship that exists between the three sets and between the various performance measures in each. Thus it is virtually impossible and certainly inappropriate to study each of them in isolation. However, because of the particular importance to study each of two sets, and their dominant position with respect to the main port users (namely the ship operator) and because this document is mainly concerned with the definition and harmonization of port performance indicators, emphasis will be given only to the first one and how the nature of the second one affects performance indicators.

(d) The duration of a ship's stay in port

17. Diagram 2 below shows the standard stages of a vessel's passage through port. The first and foremost measure of "ship productivity" through a port will concern the "total turn-round time in port" of a given vessel on a given call (generally expressed in hours). However, the "total time value" is not absolutely meaningful in itself but requires further substantiation. Thus a second measure presents total turn-round time in port as a function of cargo tonnage to be handled during that call, whilst a third measure must show the total turn-round time in port in the light of cargo composition (traditionally presented by main classes, e.g. bulk liquids, bulk solids, conventional general cargo, containerized cargo). In an economic analysis a special effort may be made to express the above-mentioned ship productivity values in monetary terms by duly taking into account the daily cost of the vessel in port (generally based on average values per type and age class, although considerable variations may exist from vessel to vessel type depending on flag, vessel management and conditions of acquisition).

18. Up to this point the "total turn-round time" in port has been examined without any breakdown of the "ship's time" periods as shown in Diagram 2. Although a reduction of any of these may improve the overall "productivity of the ship in port". at least two of these periods require special emphasis namely the "ship's waiting time for a berth" and the "ship's time at berth". These two measures are particularly crucial in ports facing latent or acute port congestion, i.e. where ships have regularly to wait before berthing because all adequate service points are already occupied.

Diagram 2
Break-down of Ships Line in Port



UNCTAD PORTS SECTION

Source: "Manual on a uniform system of port statistics and performance indicators" (UNCTAD/SHIP/185/Rev.1).

19. Ship time in a port is the physical time the vessel spends in the port during the ship call. If the vessel has not left the port, this time is the difference between the departure (Code 8) and the arrival (Code 1) of the vessel.

20. The total pre-berthing delay is the interval between arrival (Code 1) and berthing (Code 4)

21. Waiting time in a port refers to the time that the ship is physically in the port waiting. It is the pre-berthing delay minus the interval between leaving port after registering (Code 2) and returning to port (Code 3). **When the vessel does not leave port during this interval these two entries are the same.**

22. The time at berth is the interval between arrival at berth (Code 4) and leaving berth (Code 7) minus time for shifting.

23. Each complete ship call will thus require a minimum of four entries namely: arrival at port (Code 1), arrival at berth (Code 4), leaving berth (Code 7) and leaving port (Code 8).

III PERFORMANCE MEASURES/INDICATORS FOR CARGO-HANDLING ON BOARD AND ON SHORE

(a) Inter-port comparisons and norms

24. Performance indicators can be used either continuously or at a certain point in time, and these two approaches serve different purposes. Continuous indicators are used within the port and are concerned only with that port in isolation. If performance declines, this is a bad thing, no matter how that port compares with others. Any norms which are set up are the port's own norms, and they take into account the many features of the port (equipment, investment, geography, traffic) which are considered characteristic and change only slowly, if at all.

25. One-shot indicators are snapshots in time that describe that port's performance in absolute terms since a decision has to be made as to what, if anything, is wrong. As such, they are the prerogative of the expert who is called upon to make such a judgement from his experience based on other ports, and he will be bound to be making comparisons. He will have his own norms for comparison, but as an expert, he will know that the norms are meaningless unless many other factors are taken into account (type of cargo is, of course, the main one). He will, therefore also call for additional facts before he can advise, but the berth group indicators will give him a reasonable first impression.

(b) Use of performance indicators

26. The indicators must be able to show the following:

(a) How productively facilities/resources are being used, so that corrective actions can be taken to prevent waste;

(b) How intensively facilities are being used, so that planners can decide when extra facilities are needed; or when existing ones can be expanded or improved upon;

(c) The quality of the service being given to the ship-owner;

(d) The quality of the service being given to the shipper. It should be noted that the different character of each port, and of each group of berths in the port, may mean that the port management needs to select particular indicators from the set and to attach its own special importance to each.

27. This emphasis on the berth group is vital. Firstly, break-bulk general cargo berths must be kept separate from specialized classes of berth (and if any of the "wrong ships" use the berths then this has to be recorded). Secondly, different geographical groups of berths within the same class must be kept separate; it is of little help to watch the average performance of a mixture of scattered berths with different features. Wherever possible, a berth group should correspond to the span of control of an operations manager so that personal targets can be set for him. However, it must not be forgotten that although different berth groups may enjoy a degree of independence, they affect each other nevertheless.

28. While it is useful to watch any indicator in isolation to see if it changes, no general conclusions can be drawn from any one indicator in isolation.

(c) The primary indicators

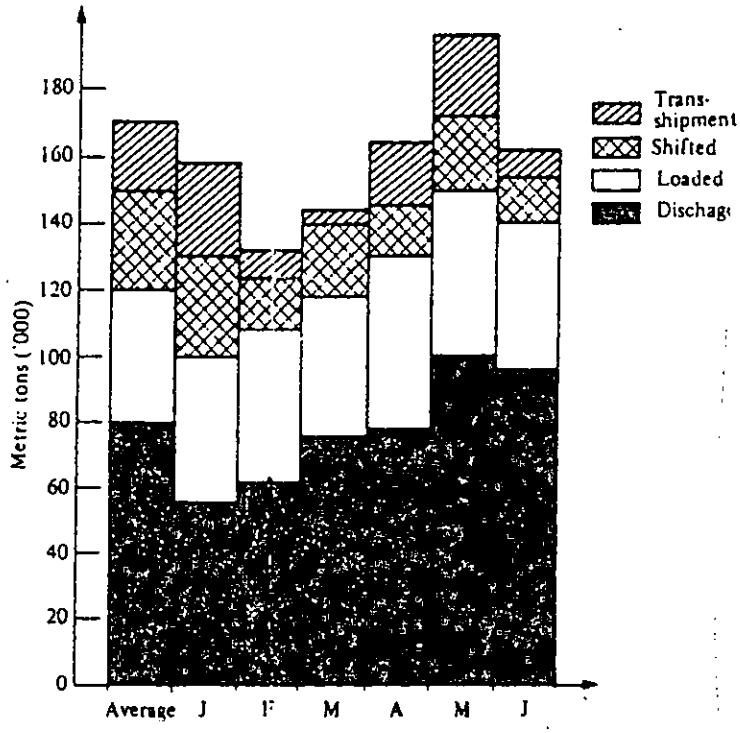
29. As suggested a set of primary indicators is given in figures 2 to 7. Figures are presented monthly in seven diagrams, and each diagram contains several measures whose comparison is of interest.

1. INDICATORS OF BERTH THROUGHPUT

30. As already discussed in Section I and as indicated in Figure 2 below, berth throughput tonnages can be described in several ways.

FIGURE 2

BERTH THROUGHPUT



Source: UNCTAD Monograph on Port Management

31. **Berth throughput measures the total tonnage of cargo handled at a berth in a stated period. Berth throughput is usually expressed on a weekly, monthly or annual basis.** It does not, however, provide an indication of how efficiently the facilities have been managed. Moreover, this measure only has significance if it is further differentiated by stipulating the type of cargo handled, the handling techniques used (e.g. grabs, conveyor belts, conventional gear, container handling equipment), the route followed (direct/or indirect route) and the units of measurement (weight tonnes, freight tonnes, measurement tonnes). It is basically a measure of "activity" on a facility.

32. The most useful measure of how fully the berth facilities throughput are being used as given by the first primary indicator:

(a) Tonnage handled per berth

33. **This is defined as the total amount of cargo discharged from and loaded onto all ships and barges tied up alongside all the berths in the group, divided by the number of berths in the group.** Tonnage worked overside is included, but tonnage

worked by ships double-banked (abreast) is not, since it is equivalent to working at moorings and is normally no measure of the use of the berth facilities themselves. The group of berths should be adjacent, and of a similar character (either break-bulk, ore, container, etc., but not a mixture of these) Tonnage should be a measure of weight (unlike freight tons which may be based on volume), and the trend is towards the metric ton (I,000 kilograms). The figure should be presented monthly and annually. There is little point in producing a weekly figure since ship-by-ship fluctuations will tend to swamp any real performance fluctuations.

34. There are a number of secondary indicators which can be used to investigate the reason for an unusual level of tonnage handled:

(a) (i) Tonnage handled per metre of quay

As (a), divided by the average berth length in the group (or, which is the same thing, the total tonnage divided by the total quay length of the berth group).

(a) (ii) Over-quay throughput

As (a), but excluding all overside working. That is, the tonnage which passed across the quay wall in either direction from any ship or barge. This is particularly useful in seeing to what extent the overside working is influencing the throughput figure. Overside working cannot normally be avoided but with the exception of direct delivery by barge, it involves double handling and hence extra cost.

(a) (iii) Over-quay throughput per metre

This is the over-quay throughput per berth defined in (a) (ii) above, divided by the average berth length. A further indicator which provides a useful link between the indicators mentioned above, and which can explain differences, is, again for each group of berths:

(a) (iv) $\frac{\textit{Average ship length}}{\textit{Average berth length}}$

Observation of this indicator year by year will reveal whether ship lengths are changing sufficiently to influence the design of future berths, or, in the extreme,. whether the division of the quay length into a different number of berths is advisable.

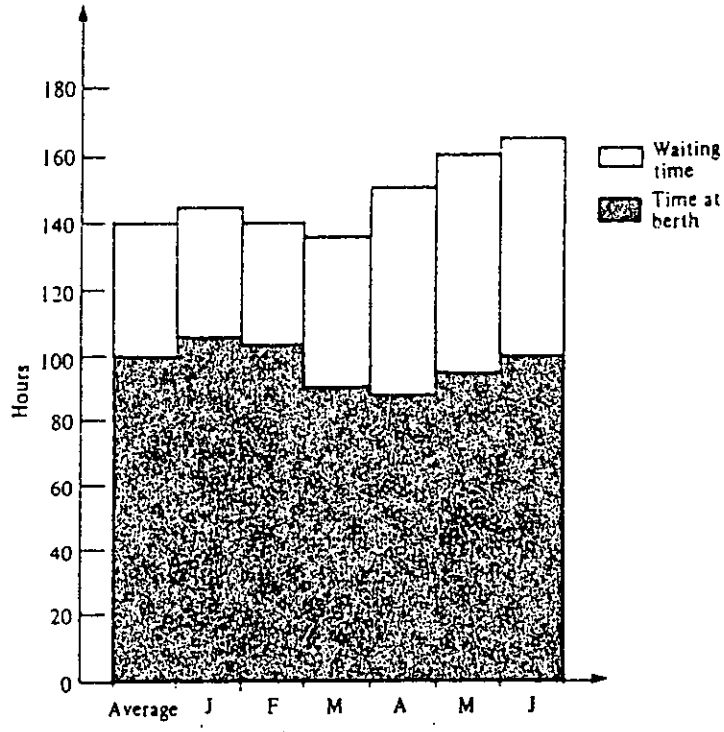
2. INDICATORS OF SHIP TURN-ROUND TIME

(b) Total time in port

From the point of view of the shipowner, and hence of the port authority in trying to judge how good a service is being given to ships, the total ship turn-round time in port is the primary indicator. As a shipowner is concerned with the total time a vessel spends in port, the ratio of waiting time to service time has little meaning. For example, two ports could have the same ratios yet the total turn-round times could be vastly different. Thus, it is wiser to keep both these times as separate indicators and not to divide one by the other. There is, furthermore, so much difference between the economics of different ship/port operations that to set up a norm for this ration has little meaning. However, although waiting time and service time are kept separate, it is convenient to plot them both in the same diagram, as shown in figure 3 below

FIGURE 3

SHIP TURNROUND TIME
(Average)



Source: UNCTAD Monograph on Port Management

36. The definitions of these further indicators are:

(b) (i) Waiting time

This is the average time a ship spends between arriving at the port and arriving at the berth where cargo-handling is to take place.

(b) (ii) Service time

This is the total time spent at the berth, including all idle times. When ships are permitted to stay at the berth at their own request although they could have vacated it, for example, at a terminal port, then this additional lying-up time may also need to be shown separately.

Both measures must be in the same unit, either hours or days, but preferably the former. They are calculated only for those ships calling at that berth group, even though the waiting time indicator my be strongly influenced by the performance of another group of berths, if the two share the same class of ship.

3. INDICATORS OF BERTH OCCUPANCY

37. Berth occupancy (See figure 4) taken by itself is a particularly dangerous basis for decision-making. This is in the first place because high berth occupancy can be either a good thing or a bad thing: it is good, if ships lie at berths when they want to, paying dues and with no other ship waiting; it is bad if there is no freedom to use the right berth for the right ship because there is always a queue. In the second place a reduction in berth occupancy can be the result of either good or bad policies: good, if they mean faster working, bad, if they mean that high costs are sending ships to another port. Finally, the danger lies in the difficulty of agreeing on a definition.

Figure 4 Alternative Definitions of Berth Occupancy

SHIP

	Hours working at Berth A	Total Hours at the Berth (B)
Hours during which work normally takes place (C)	$\frac{A}{B}$ = Utilization of Working time	$\frac{B}{C}$ = is not meaningful
All hours (D)	$\frac{A}{B}$ = Net Berth Utilization	$\frac{B}{D}$ = Gross berth occupancy

There are three possible definitions of berth occupancy, as shown in figure 4 The most useful single primary indicator, which gives an estimate of the level of demand of the berth group, is taken from the bottom right-hand corner of figure 4 It is the gross berth occupancy, described below.

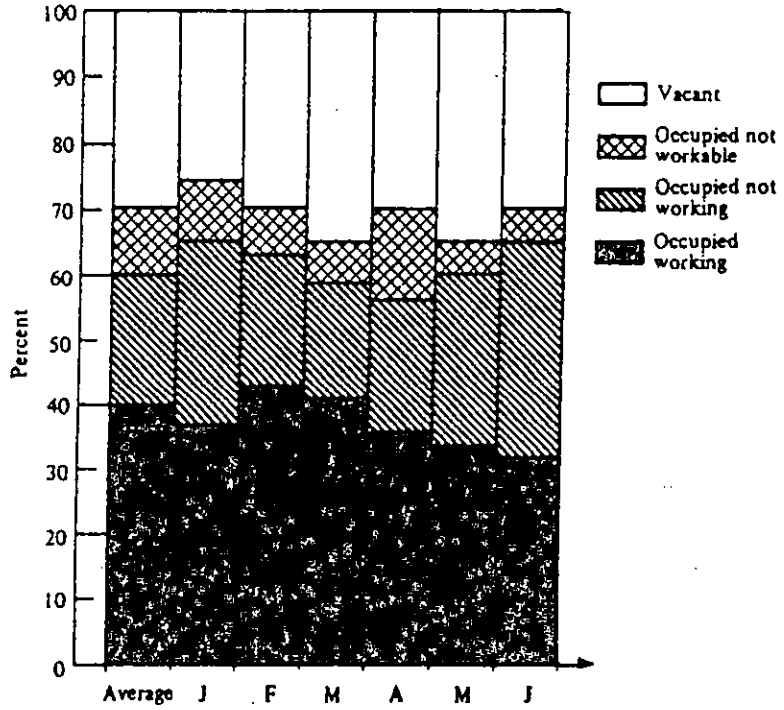
(c) Gross rate of berth occupancy

The definition of this is the total number of hours the berths were occupied by a ship (or by a group of barges equivalent to a ship), divided by the total number of hours (24 hours per day, 7 days per week) and by the number of berths in the group.

In figure 5 this is plotted as the total shaded portion - for example, the first month's figure is 75 per cent gross berth occupancy.

FIGURE 5

BERTH OCCUPANCY



Source: UNCTAD Monograph on Port Management

41. Also shown in 5 are some secondary indicators, all expressed as percentages of the total time:

(c) (i) ***Hours spent by ships at the berth actually working.***

(c) (ii) ***Hours spent by ships at the berth not working during normal working hours (which could have been worked).***

(c) (iii) ***Hours spent by ships at the berth not working outside normal working hours.***

42. It will be seen that (c) (i), (c) (ii) and (c) (iii) naturally total up to (c), and it should be very clear to port managers what the significance of this breakdown is.

43. As mentioned earlier, some cargo-handling berth groups may suffer substantially from being occupied by the "wrong ships" - passenger ships, car ferries, naval vessels, vessels in port for bunkering and repair, or bulk cargo ships using break-bulk berths, etc. This false occupation of the berths will distort the relation between berth occupancy and annual tonnage handled and when it becomes substantial it should be recorded separately as a further indicator:

(c) (iv) Hours spent at the berths by ships berthed for reasons other than the primary purpose for which the berth group is intended.

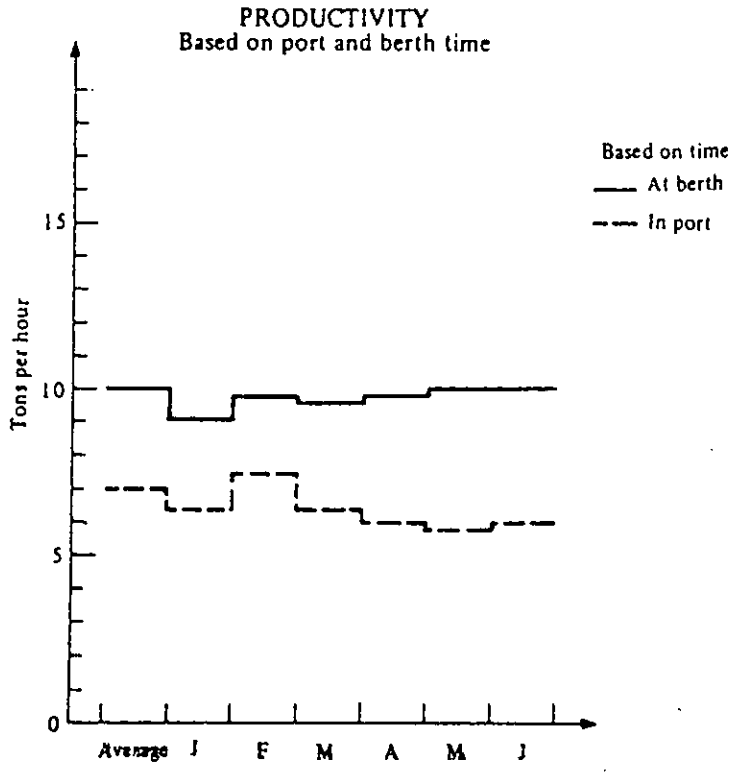
4 INDICATORS OF SHIP PRODUCTIVITY

44. The speed at which ships are worked is a further important measure of performance. There are many possible primary indicators, but it is suggested that the tons per hour when working (see figure 6) is the clearest indicator of the cargo-handling efficiency of the berths. This means the total tonnage of all gangs, and thus takes into account both the intensity of allocating gangs and the hourly productivity of each gang. The recommended primary indicators are therefore:

(a) Tons per ship working hour

45. This is the average tonnage per ship discharged or loaded, divided by the average number of hours per ship spent in discharging or loading.

FIGURE 6



Source: UNCTAD Monograph on Port Management

Ship output measures give a clear indication of how good cargo-handling operations are. Nevertheless, these figures still require the same differentiation as mentioned for berth throughput. The more frequently used measures include:

Tonnes per ship working hour;
Tonnes per ship hour at berth;
Tonnes per ship hour in port.

Large differences between these values will indicate considerable time losses for the ship at the berth or in the port.

There are two secondary indicators which are almost as significant and which can be presented, as in Figure 6. They are given less importance here because they provide only back-up information which can already be deduced from indicators (b) (i) and (c) (i) - (c) (iii). They are:

(d) (i) Tons per ship hour at berth

This is (d) modified by including all the hours the ship spent at the berth not working and will be lower to the extent that the ships were not worked 24 hours a day. **It is calculated by dividing average tonnage by average service time**; and

(d) (ii) Tons per ship hour in port

This is (d) modified further to include all hours in port, and will be lower than (d) (i) according to the extent that ships wait for berths.

49. In addition, when there is a need to investigate in greater detail the reasons for a deviation in productivity, there is much to be gained if the port management has access to the same figures ship-by-ship, and cargo-class by cargo-class. These breakdowns will all be obtainable from the same basic data, but will need extra effort to maintain.

50. A simplified example may well illustrate the importance of comparing these three measures. Let us assume that a vessel arrived in port at 4 a.m., berthed at 5 a.m., started working at 8 a.m., finished operations at 6 p.m., left berth at 11 p.m. and left port at midnight, and that during her stay she handled a total of 1,000 tonnes of general cargo. The respective output measures would then be:

Tonnes per ship working hour: 1,000 tonnes/10 hours = 100 tonnes/hour;

Tonnes per ship hour at berth: 1,000 tonnes/18 hours = 55 tonnes/hour;

Tonnes per ship hour in port: 1,000 tonnes/20 hours = 50 tonnes/hour.

Many ship operators will also calculate the following:

Ship output per 24 hours in port: $\frac{\text{1,000 tonnes x 24 hours}}{\text{20 hours}}$ = 1,200 tonnes/ per 24 hours.

51. In this very simplified example it is obvious that the gap between 55 tonnes per hour at berth and the 100 tonnes per ship working hour points to waste of time at the berth, when the vessel is not being operated. Although this example does not permit the pinpointing of the exact reasons why the ship registered a considerable amount of non-operational time, the port traffic manager certainly should be motivated to investigate the underlying causes and take the necessary remedial action.

52. Three further indicators can explain a good deal about the reasons for high or low ship productivity.

They are:

(d) (iii) Average number of gangs employed per ship per shift

(d) (iv) Average tonnage per ship discharged or loaded

Discharge and loading tonnages are best kept separate, since the object of this indicator is to watch the length of continuity of the operation. This continuity is one of the main factors determining the speed of cargo-handling which the port can obtain; and

(d) (v) Tons per gang-hour

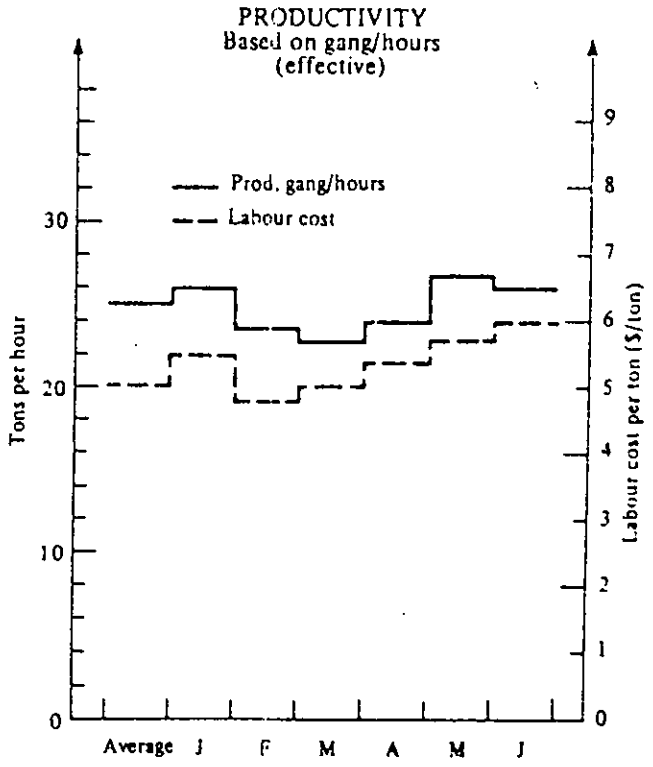
This is a good indicator (See figure 7) but must, of course, be maintained separately for each main cargo class.

53. It is a measure of gang output. This is the average quantity (tonnes) of cargo handled by a gang in a certain time interval, normally an hour. This then is the most significant value regarding the performance of labour, although once more the bare "tonnes per gang-hour" measure needs to be completed by explanatory data on such factors as the gang composition, the cargoes worked, the ship's configuration and many others before any valid conclusions can be arrived at. One more refinement certain analysts aim for is to express output in man/hours rather than gang/hours, thus eliminating the distorting factor "gang composition". It may also be worthwhile emphasizing that in container terminals, output is now measured in "containers per gross or net crane hour", as the notion of a gang in such operations is no longer a realistic one.

5. INDICATORS OF LABOUR PRODUCTIVITY

54. This report is confined to operational matters only, and cost analyses are outside its scope. However, any operational analysis would be incomplete without considering the level of manning which was used to achieve the productivity. To avoid all difficulties of calculation, a simple indicator can be built by considering the total labour bill for the berth group during the period. This figure should not be too difficult to produce. The extent to which supervisory staff are included, the question of including stevedoring labour, and many other variations, can be decided according to local preference, but the essential thing is that the same basis for calculation should be used each month.

FIGURE 7



Source: UNCTAD Monograph on Port Management

(e) Labour cost per ton

This is obtained by dividing the total cost of labour employed at the berth group (including gangs on the ship, on the quay and in the sheds), by the total tonnage handled during the same period.

IV. ACTION NECESSARY TO IMPROVE AND SUSTAIN PORT PERFORMANCE

A. Introduction

In this report a number of areas of berth operations are discussed, and in each it is found that there is often scope for bringing about an improvement in performance. Some of these improvements are practical points such as might be given in advice by a cargo-handling expert. Many more are concerned with methods of operations planning.

This chapter reviews the main improvements which may be possible in each part of the berth system. It also suggests how to go about finding where one

57. This chapter reviews the main improvements which may be possible in each part of the berth system. It also suggests how to go about finding where one particular port should place the emphasis. It is not suggested that in any port everything can be put right, or that the enormous throughput which a perfect berth is capable of can be achieved, but there is unlikely to be a single port in the world where an over-all increase in throughput of 10 per cent could not be achieved (and in the majority of cases considerably more).

B. Suggested operational improvements

58. The following operational improvements are suggested to port managers:

1. Ship Berthing

(a) The berthing policy should not be too rigid. Whatever the normal system, the ability of the berth to accept the cargo should always be taken into account before allocating the berth.

(b) Cargo-handling berths should not be taken up by ships which have no cargo to discharge or load. After completion, ships should at once be shifted away to make room for the next vessel.

(c) When a ship has only a very small quantity of cargo to handle, an attempt should be made to work it elsewhere than alongside a main berth if other ships are waiting.

2. Stevedoring

(a) There is often scope for putting on more gangs per ship, and for more double-gang working in the commanding batch.

(b) Each on-board gang must be matched by the quay-side gang and equipment, and the sorting and tallying gang, so that all can work, at the same average speed.

(c) There is usually scope for extending the ship working hours per day, but when done this must extend throughout the berth operation.

(d) A big gain can often be made by co-ordinating the whole cargo-handling operation between ship and store (or to direct delivery) If this co-ordinated operation is all under the control of one supervisor,

the gain can be even greater. The performance of a group of berths is dependent more on the skill of such a man than on any other factor.

(e) This manager needs to be on the quayside to take quick decisions according to the changing conditions.

(f) Gains can be made by using more suitable handling gear, by pre-slinging, by using loading-boards, etc., and it is important to be flexible and to use the right gear for each class of cargo.

(g) The guiding principle of the operation should be that the cargo is put down and picked up the fewest possible number of times.

3. <u>Quayside Operations</u>

(a) The transfer from ship-side to shed, open storage, or delivery vehicle should always be designed to keep up with the natural speed of the hook. This is the biggest single source of failure in general cargo break-bulk operations.

(b) There is a proper choice to be made between tractors plus trailers, fork-lift trucks, etc., for each operation. This choice has to be flexible and to take account of the cargo, the distances involved, the nature of the store and the availability of equipment. There should be a quayside manager constantly concerned with these decisions.

4. <u>Transit sheds and open storage</u>

(a) The state of the sheds should always be taken into account in planning the method of working the ship. There is often scope for adjusting the programme of working the non-commanding hatches so as to give sheds time to recover or prepare.

(b) When it is needed, the holding capacity of a shed can often be greatly increased by careful discipline, higher stacking and avoiding waste spaces. This calls for highly trained shed staff.

(c) The period during which cargo stays in the shed before delivery is often much too long. This is usually the result of tradition, and attention should be paid to encouraging earlier collection. This can often be the most important single management action which will eliminate congestion.

(d) Congestion in storage areas slows down the ship operation. Cargo remaining from one vessel should never be allowed to impede the working of the next one.

(e) Alleyways, exits, entrances and means of access to road/rail should never be blocked. When storage areas are so full that this is beginning to occur, it may be better to stop landing further cargo until they have been cleared, or alternatively temporarily to re-route cargo.

(f) Transit areas needed for cargo should never be taken up by the port's own stores. This applies, for example, to large engineering structures, which should always be moved out of the berth working area.

5 **Delivery**

(a) Delivery points from transit storage should be chosen so as to avoid interfering with the ship operation.

(b) Direct delivery needs to be extremely well planned - if it is not to slow down the natural speed of the hook.

(c) The correct choice of direct delivery depends on many factors. When the right choice is made, costs can be cut and the ship need not be delayed.

6. **Routing**

(a) There is more scope for varying the route that cargo follows through the berth, and the mode of discharge, than many ports realize. By flexibility in routing it is possible to increase the average throughput of a berth.

59. In the light of these main points and many more subsidiary ones, it is clear that the improvement of berth operations is a complex task. Further, since every part of the berth interacts with every other part, it is very difficult for port managers to see which of the many possible faults is hampering their operations. In fact it is probable that a busy port management will find the tasks of systematic improvement too time-consuming. An alternative which ports, may wish to consider is the setting up of a small project team.

C. A Berth Throughput Project Team

60. If this approach were adopted, a typical team might consist of a full-time project leader and two full-time assistants. Their main work could very probably be completed in six months, although the continuing need to improve performance might give them a permanent role, particularly in a large port.

61. The terms of reference of the team would be to study the berth operations in sufficient detail, both by observation and by data collection and analysis, to enable them to determine which are the main areas of activity in need of improvement, and to what extent. In doing this it would be wise for them to spend enough time on the quayside and in the sheds to be able to judge how the basic method described in this report applies locally and then to use the method itself to find the port's existing bottle-necks.

62. They should also consider which of the performance indicators discussed in Chapter III are most important to the port, organize the continuous collection and analysis of information which is needed to provide these indicators, and then transfer this tasks to the permanent statistical section. In the carrying about of this exercise it is necessary to be completely certain that the data collected are in fact what they are supposed to be. The results of the analysis will be valid only to the extent that the data are accurate.

63. The ideal team would be one led by an energetic and imaginative manager, operations research specialists perhaps even from outside the orbit of the port, supported by a member of the traffic department and a member of the statistical section or its equivalent. All members of the team would benefit from attending a good course in modern management techniques; indeed, time spent with such a team might well be considered part of the training for more senior management positions.

D. Action by Senior Management

64. During such a six-month project it would be wise to hold monthly meetings of senior management at which the project leader would describe progress. As the bottle-necks begin to be found, it will be necessary to decide which of the following methods to use to try to eliminate them:

(a) Improvements in operational methods'

(b) Better planning and more flexibility;

PORT SECTOR PERFORMANCE/EFFICIENCY INDICATORS

INDICATOR	UNIT		COMMENTS
Traffic			
Vessels type repartition (General Cargo, Containers-Carries, Dry-Bulk)	Percentage	T	
Outward traffic - Total - of which transit	 Tons Tons	 T T	To be desegregated per type of cargo and packaging
Inward traffic - Total - of which transit			To be desegregated per type of cargo and packaging
Transshipment traffic	Tons	T	
Transit traffic	Tons	TP	
Container traffic (Domestic + Transit + Transhipped	TEUs	TP	
Port Operation Performances			
Gross berth occupancy (General Cargo, Containers, Dry-Bulk, Liquid-Bulk)	Percentage	TP	To be desegregated per type of berth
Average waiting time in port before and after berthing (General Cargo, Containers, Dry-Bulk, Liquid-Bulk)	Hours	TP	To be divided according to the causes of the waiting

* Type of indicators: W = Welfare; T = Technical; and P = Project

PORT SECTOR PERFORMANCE/EFFICIENCY INDICATORS

INDICATOR	UNIT		COMMENTS
Average time at berth (General Cargo, containers, dry bulk, liquid bulk	Hours or Days	TP	To be desegregated per type of good
Average tons loaded/unloaded per ship in berth per day	Tons/Ship/ Day	TP	
Handling performance per working hour	Tons/man/H our	TP	To be desegregated per type of goods
Tonnage handled per linear meter of quay	Tons/Meter	TP	To be desegregated per type of quays
Average daily handling performance by berth for containers (TEUs per ship in berth)	TEUs	TP	To be desegregated per type of berth
Degree containerization[1/]	Percentage	TP	
Handling performance for containers	TEU/Crane/ Hour	TP	TEU = Twenty foot Equivalent Units
Average dwelt time for containers	Days	TP	
Financial			
Working Ratio	Percentage	TP	
Operating Ratio	Percentage	TP	
Net Income	US$	TP	
Return on asset [2/]	Percentage	TP	The method of calculation for depreciation has to be mentioned

* Type of indicators: W = Welfare; T = Technical; and P = Project