
Port statistics



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Port statistics

**Selection, collection and presentation
of port information and statistics**

Manual prepared by the UNCTAD secretariat



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CONTENTS

	<i>Page</i>
Introduction	1
Letter dated 18 September 1970 from the Expert Group on Port Statistics addressed to the Secretary-General of UNCTAD	2
List of participants at the meeting of the Expert Group on Port Statistics . .	3
<i>Chapter</i>	
	<i>Paragraphs</i>
I. Purposes of port information	1-9 5
II. Selection of useful data in ports	10-58 7
A. Data on port facilities and port services	12-20 7
B. Data on ship traffic	21-27 8
C. Data on port operations	28-33 9
D. Data on cargo flows and passenger traffic	34-47 10
E. Data on port labour	48 12
F. Data on costs and revenues	49-52 12
G. Other data	53-58 13
III. Collection and presentation of port statistics	59-81 18
A. Sources of data	60-69 18
B. Method of collection	70-76 19
C. Organization of data collection	77-80 20
D. Presentation of port statistics and information	81 21

ANNEXES

I. Examples of forms for data collection	25
II. Models for tables of port statistics	28

INTRODUCTION

At its third session, the Committee on Shipping requested the UNCTAD secretariat "to give priority, within its current work programme on ports, to its work on port statistics and to produce a comprehensive guide to the collection and use of port statistics for administrative and analytical purposes essential for the improvement of ports".¹ This priority is justified because accurate and up-to-date information and statistics are essential tools for effective management of ports, as of any other enterprise. Modern methods developed to improve either port operations or port planning also need large amounts of statistical information. One of these methods has been described in a previous report of the secretariat on the improvement of port operations and connected facilities, which points out that "this more sophisticated exercise poses a large number of statistical problems, and the method can only be used in cases where adequate statistical data are available. Hence an important part of the future research into the development of ports will be concerned with the development of port statistics to a point where they will permit such methods of analysis to be applied."²

The present manual is an attempt to advise port authorities on what data should be recorded and how to collect and present them. At this stage, it has not seemed advisable to suggest the complete standardization of port statistics, because it is acknowledged that all statistical requirements of all ports are not identical, owing to the great variety of legal, administrative and organizational circumstances in which information and statistical systems have to be established and operated. Nevertheless, while the complete standardization of port statistics cannot be attempted at present, uniformity is needed in the methods and forms of collection and presentation. Therefore, general principles are suggested in connexion with the ways of collecting and presenting port statistics, in order to facilitate, *inter alia*, port to port comparisons, both at national and international level. Such comparisons are not only of value for broad analytical purpose, but also essential for any port's evaluation of its performance. They have therefore a very practical objective.

In the first chapter, the various purposes of gathering information and statistical data on ports are discussed. It can be seen that this list of data goes beyond statistics as the term is generally understood, and covers management information in general. In the second chapter, the

main types of port data are reviewed and their different uses are indicated. From this list, individual port authorities should be able to select those items which are of particular interest to them, in addition to those items suggested as a basic minimum which all ports should have. The third chapter deals with the collection and the presentation of port information and statistics. The main sources of data are indicated and several methods of collection are described, taking into account the fact that each port has to choose a method adapted to its requirements and resources. A selection of statistical returns is suggested, with an indication of their appropriate frequency.

In accordance with the suggestion made and accepted at the fourth session of the Committee on Shipping,³ a draft version of this manual was reviewed by an Expert Group which met in Geneva from 14 to 18 September 1970. Six out of seven port statisticians invited by the Secretary-General of UNCTAD were able to join the Group and their appreciation of the report is expressed in the letter reproduced after this introduction. The present manual incorporates in an aggregate fashion the suggestions made by the experts. Advantage was also taken of valuable comments made by the United Nations Statistical Office, the International Labour Office (ILO), the International Bank for Reconstruction and Development (IBRD) and the Inter-Governmental Maritime Consultative Organization (IMCO). The responsibility for the final text, however, is that of the UNCTAD secretariat.

At its fifth session, the Committee on Shipping discussed the manual and many delegations expressed their appreciation of the work done by the secretariat. Three delegations suggested minor amendments, most of which have been incorporated in this printed version. Finally the Committee on Shipping adopted the following resolution:⁴

The Committee on Shipping

Considering that adequate statistical and other information on port operations is essential for the efficient working of ports and for the formulation of policies concerning improvements and investments in ports and concerning port charges and dues,

Further considering that the comparison of data collected in various ports would facilitate a meaningful assessment to be made of the efficiency of these ports,

¹ See the report of the Committee on Shipping on its third session (*Official Records of the Trade and Development Board, Ninth Session, Supplement No. 3 (TD/B/240)*), annex I, resolution 6 (III).

² See *Development of Ports: Improvement of port operations and connected facilities—Preliminary report by the UNCTAD secretariat* (United Nations publication, Sales No.: E.69.II.D.17), para. 3.

³ See the report of the Committee on Shipping on its fourth session (*Official Records of the Trade and Development Board, Tenth Session, Supplement No. 5 (TD/B/301)*), chap. VII, para. 123.

⁴ See the report of the Committee on Shipping on the first part of its fifth session (*Official Records of the Trade and Development Board, Eleventh Session, Supplement No. 3 (TD/B/347)*), annex I, resolution 18 (V).

Taking note with appreciation of the manual on the selection, collection and presentation of port information and statistics (TD/B/C.4/79 and Corr.) prepared by the UNCTAD secretariat with the assistance of the group of experts on port statistics and with the co-operation of the United Nations Statistical Office, the statistical divisions of the regional economic commissions, the International Labour Office, the International Bank for Reconstruction and Development and the Inter-Governmental Maritime Consultative Organization, and bearing in mind the views expressed during the first part of its fifth session on the subject of port information and statistics,

1. *Requests* the UNCTAD secretariat, in preparing the final text of the manual, to take into account the views expressed;

2. *Commends* the UNCTAD secretariat's manual to the attention of the States members of UNCTAD, in particular developing countries, for transmission to port administrations and for implementation as appropriate, and suggests that the attention of all interested parties be drawn to this manual;

3. *Recommends* that, through the appropriate channels, the United Nations regional economic commissions and the United Nations Economic and Social Office in Beirut be invited to support requests for appropriate assistance through the United Nations Development Programme for the implementation within their regions of the recommended methods for the selection, collection and presentation of port data, bearing in mind the need for data which are comparable on a regional and global basis.

Letter dated 18 September 1970 from the Expert Group on Port Statistics addressed to the Secretary-General of UNCTAD

Dear Dr. Perez Guerrero,

You invited us to meet in Geneva as a group of experts to consider questions related to the collection and presentation of statistics of ports, with particular reference to the problem of establishing a manual of statistics which might be adopted by developing countries. We were very happy indeed to accept this invitation and to have the opportunity of considering this most important subject.

At present the statistical services in most of the ports of the world are grossly inadequate. They remain on a basis adopted when ports were relatively small-scale undertakings and only the simplest records of the movements of goods through the ports and ships into and out of the port were considered necessary. Today, however, ports are large-scale undertakings and with technological progress in shipping leading to the widespread adoption of unitized methods of handling cargo, the amount of capital needed in ports is rapidly increasing. The inadequate statistics collected in most ports provide a proper basis neither for assessing the needs of the ports in terms of development, nor for ensuring that the expensive capital equipment is being efficiently used. The need is particularly acute in developing countries which, because of their shortage of capital, have a particular need to assure themselves that the right investment decisions are being made and, once the investment has been made, the capital equipment is used efficiently. These things cannot be done on the basis of the inadequate information at present available to most port authorities.

The information needed can be obtained only by the collection of accurate statistics covering the most important aspects of the operations of a port and their presentation in a proper form. These statistics are essential tools for a port management in order to secure efficiency in the working of a port. The establishment of efficiency indicators for each part of the operations of a port, so that its costs and performance can be kept under continuous review, cannot be undertaken unless the statistical basis for these is available. For the development of ports, forecasts of future ship and cargo flows through the port

are required; such forecasts can be made on a realistic basis only when the proper statistics of past and present operations are available.

We regard it as important that so far as possible all ports should adopt a common basis for their statistical data and that this basis should, wherever appropriate, be related to the classifications commonly used in international trade statistics. This common basis is needed in order to secure comparability between statistics derived from different ports, for it is only if statistics are comparable that the performance of different ports can be compared. In port management the comparison of the performance of its port with that of others is an important means of testing the results yielded by its own efficiency indicators and for calling attention to areas where improvements are required.

There is a substantial body of statistical data which it is vital for every port to collect. However, the statistical needs of each port are somewhat different depending on the institutional structure of the port and the relationship between these institutions and other sections of the national economy. As a result, there are other statistics which every port need not collect regularly, but which may be vital to some ports. The judgement as to whether any particular pieces of information are required on a continuous basis for the operations of the port is one which can only be made by the port management itself. Where the management lacks the expertise to make that judgement it seems to us that assistance through UNCTAD is an appropriate means to enable the decision to be made.

In this connexion, we would like to call attention to the role which sampling can play as an alternative to the continuous collection of statistics. For statistical data which a port may not wish to collect on a regular basis, *ad hoc* intensive investigations of particular aspects of the operations will provide quantitative data for checking the efficiency of those aspects. No rules can be laid down regarding the proper role of sampling as opposed to continuous collection, since the right decision in this regard will depend on the particular situation and circumstances of the port concerned.

We had before us in our discussions a draft manual prepared by the Division for Invisibles of the UNCTAD secretariat. We regard this draft manual as being a highly competent document providing excellent guidance to the authorities in developing and other countries for the establishment of better statistical processes. The widespread adoption by ports of the statistical practices suggested there would eliminate the present inadequacies of statistical data to which we referred above. The final report of the secretariat, modified in the light of the

discussions held, will, in our opinion, be a suitable document to place before the Committee on Shipping and will constitute a manual of statistical practices, the adoption of which by port authorities will provide a sound basis for management decision-making.

We would like to thank the secretariat for their excellent work in preparing the document and for the manner in which they prepared and serviced our meeting.

Yours sincerely,

J. GILBERT

E. NADARAJAH

M. KRZYZANOWSKI

J. C. VAN OOSTENRIJK

E. LUGO GALVIS

B. WILSON

**List of participants at the meeting of the Expert Group
on Port Statistics**

Geneva—14 to 18 September 1970

- Mr. E. LUGO GALVIS (Colombia), Head of the Department of Statistics and Control of Operations, Colombian Ports Authority, Bogotá; Professor of General Statistics, University of Bogotá.
- Mr. J. GILBERT (United States of America), Trade Economist, Port of New York Authority; Professor, New York University Graduate School of Business.
- Dr. Maciej KRZYZANOWSKI (Poland), Associate Professor of Economics, Director of Research, Maritime Institute, Gdansk, Poland.
- Mr. E. NADARAJAH (Ceylon), Statistician, Port (cargo) Corporation and Colombo Port Commission.
- Mr. J. C. VAN OOSTENRIJK (The Netherlands), Chief Statistician, Municipal Port Administration, Rotterdam.
- Mr. B. WILSON (United Kingdom of Great Britain and Northern Ireland), Chief Statistician, National Ports Council, London.

Excused:

- Mr. S. NGANN YONN (Cameroon), Director of the Port of Douala.

Chapter I

PURPOSES OF PORT INFORMATION

1. There are several reasons for collecting statistical and other data related to ports. The traditional one is to show the role of the port within the national economy. This appears in the amount of investment expenditure, the number of ships visiting the port and their tonnages, the volume of goods loaded and discharged, classified by main groups of commodities, the number of workers engaged in the port industry, etc. In many ports, the statistical function is still limited to the production of such traditional aggregates, which are published for general information.

2. Statistical and other data are used as tools for improving port operations. The management may wish to compare, on a continuous basis, the actual port activity with its potential. The data collected for this purpose should provide an intimate understanding of the functioning of the port. This is essential in order that the necessary decisions for increasing the efficiency of the port can be taken. The port activity is a complex one, because most of its components are closely inter-related. As a result, a decision which is good for one sector may produce unfavourable effects in other sectors of the port. A sound decision should therefore be preceded by a detailed analysis of the possible effects on the whole system. This is only possible if the relations between the parts of the system can be quantified with the help of accurate data.

3. For management purposes certain efficiency indicators are needed, such as :

- Occupancy rate⁵ for each homogeneous group of berths (e.g. general cargo berths, bulk traffic berths, container berths etc. ... (monthly and annually);
- Average time spent by ship at berth when loading/discharging (monthly and annually);
- Average waiting time of ships (monthly and annually);
- Ratio between the working time and the total turnaround time of ships (monthly and annually);
- Average amount of cargo discharged/loaded by a ship at the port (monthly and annually);
- Number of gangs required and actually working in port (daily and weekly);
- Number of cranes required and actually working in port (daily and weekly);
- Number of forklift trucks required and actually working in port (daily and weekly);

- Number of lorries and trailers required and actually working in port (daily and weekly);
- Throughput per berth (monthly and annually);
- Throughput per metre of quay (monthly and annually);
- Average throughput per ship/day in port, for each type of ship and each class of ship size (monthly and annually);
- Average throughput per man/hour in port (monthly and annually);
- Average throughput per gang/shift in port (monthly and annually);
- Average amount of goods in each type of storage in port (monthly and annually);
- Average time spent by cargo (loaded and discharged) in port storage (monthly and annually).

When some of these figures cannot be derived from data recorded on a continuous basis, a sampling process may be used if necessary.

4. Another purpose of collecting information and presenting it in a systematic form is to provide an appropriate basis for planning port development. The concern of port authorities and national planners with port planning is justified by the very large cost of providing and maintaining the port facilities, such as breakwaters, locks, dredged deep water berths etc., by the frequent indivisibility of port investments, by the difficulty of changing the layout of a port once made and also by the uncertainty regarding forecasts of future traffic and new technologies. The problem of how much, where and when to invest is therefore of crucial importance because a mistake may have a strong negative influence for a very long time to come. Hence the need for having adequate and accurate information, since this forms the real basis for any decision-making process.

5. The first task in this respect is to forecast the flow of goods and the ship traffic for future years, taking into account, among other considerations, the evolution towards new technologies in ship design, handling methods, and types of packaging. This exercise is first based on a close examination of the port traffic during the recent past. This traffic has to be analysed by main types of commodities, in order to identify the existing trends. In some ports, the transit traffic represents a large fraction of the total traffic handled and special attention should therefore be given to the data needed for forecasting this additional transit traffic.

6. The second task is to compare individual investment projects in the port in order to determine the optimum project. Here again, the interrelations between all parts

⁵ See below annex II, model table J.

of the port should be considered, in order to appraise the over-all result of any individual project. The information and statistical system of the port has to provide all the data, including cost data, necessary to quantify these relationships.

7. Owing to the complexity of port planning, many ports request the help of external consultants or international agencies having competence to provide technical assistance in the field of ports. This in no way reduces the data requirements; in fact the value of such external assistance depends to a large extent on the availability of accurate and up-to-date information, since it is through such information, both statistical and non-statistical, that the external consultant gains his knowledge of the functioning of the port.

8. In addition, it should be noted that information and statistical data related to the port may be useful in other fields of research. In effect, ports are increasingly

regarded as links between various means of transport and many data concerning these means of transport are therefore concentrated in ports. As far as shipping is concerned, it can be said that ports are an important source of data for studies related to subjects such as structure and level of freight rates, national shipping policy, organization of shipping services etc. Bearing in mind the large proportion of shipping costs arising in ports, it seems that insufficient attention has been given to this important aspect of port information.

9. Port information can also be used to assess the justification of freight surcharges applied by shipping conferences to congested ports. Since the decisions of conferences regarding surcharges are based on the time spent by their ship in ports, it is important for port authorities to compile data on turn-round time of ships. These data should be collected on a standardized basis to make possible comparisons between different ports.

Chapter II

SELECTION OF USEFUL DATA IN PORTS

10. Almost every port keeps track of a certain amount of data regarding various aspects of its activity. However, it seems that port statistics as such exist only where there is a clear intention to organize and rationalize the collection of a selected amount of data to achieve specific ends. The problem for each port is, therefore, to identify those data which are important enough to record in relation to a set of objectives. In this chapter, the main types of data that it is possible to collect in a port will be reviewed, and their specific significance indicated. Some data are basic and should be collected in every port. The decision whether to collect other data depends on the statistical requirements of ports which may differ from one port to another, given the wide variety of types of organization encountered in ports. In developing countries, the assessment of the real requirements regarding port statistics and information may present some difficulties and, in some cases, assistance in this respect may be provided by UNCTAD through the United Nations Development Programme (UNDP).

11. The statistical and other information concerning a port can be broken down into the following categories:

- A. Data on port facilities and port services
- B. Data on ship traffic
- C. Data on port operations
- D. Data on cargo flows and passenger traffic
- E. Data on port labour
- F. Data on costs and revenues
- G. Other data.

Each of these categories is reviewed below.

A. Data on port facilities and port services

12. A first group of data concerns the port organization itself. These data are basic and their collection should be undertaken by all ports. It is for instance important for the port authority to know the number of independent firms involved in all aspects of port operations, their legal status and the functions performed by each of them. The need for such information appears mainly in ports where a large number of activities are in hands of private firms, but is not restricted to such ports. Although the port organization does not change frequently, it is important to keep this information up to date.

13. It is also essential to have adequate information on port facilities, whether owned by the port authority or by private firms operating within the port. This information must cover the main technical characteris-

tics, the capacity, the age and the state of maintenance of each item of equipment. When new equipment is introduced the corresponding data must be carefully up-dated. The same applies to the removal of obsolete equipment and to any significant modification of existing facilities. This is important in order to measure the impact of these changes on factors such as the throughput per berth, the turn-round time of ships, the manpower requirements, etc. Despite the fact that, owing to the fairly permanent character of the equipment, this information regarding port facilities is easy to produce, precise and up-to-date information is difficult to trace in many ports.

14. A port is characterized primarily by its berthing facilities; these are used in calculations of such ratios as berth occupancy, throughput per metre of quay or per berth, etc. It is sometimes difficult to stipulate the exact number of berths in a port. The problem is simple when a berth can only be used by one ship. This is usually the case for oil berths, roll-on/roll-off berths, passenger berths. But when several berths having approximately the same characteristics are adjacent, it is possible to berth a variable number of ships, depending on their length. In this case an average number of berths can be estimated by dividing the total length of berth by the average length of ships visiting this part of the port, with due allowance for the space between ships. Sometimes, the number of berths is determined by the adjacent storage facilities (one shed, one berth).

15. The berths should then be classified by types, that is, according to the type of equipment associated with them. The following classification of berths might be suggested:

General cargo berths

Specialized berths such as:

- Passenger berths;
- Oil berths;
- Coal berths;
- Ore berths;
- Grain berths;
- Timber berths;
- Roll-on/roll-off berths;
- Container berths;
- Mixed berths (e.g. passenger with general cargo; container with ore; etc.).

The number of types of berth for each port will therefore depend on the composition of the port traffic and the type and size of ships visiting it. For each type, the total

length of berth and the number of berths should be indicated. When the port provides for handling operations on ships at buoys (trans-shipments or use of lighters) the number of such mooring points should also be specified.

16. Within each type of berth, a further classification should be made according to the depth of water alongside each berth. The depth of water at the berth determines the maximum size of ship which can be accommodated, and thus also the characteristics of other port facilities, such as entrance channels, turning basins, and locks.

17. In addition, it is necessary to record the variation of the depth of water at regular intervals and at different points (alongside the berths, in entrance channels and turning basins), to determine the speed of siltation and then the frequency of dredging works to maintain the appropriate depths of water in these various points.

18. Finally, data on berthing facilities should include the description of fixed equipment associated with each berth, for instance:

Characteristics of the quay apron: width and specifications of transport facilities provided (e.g. railway tracks, roads, pipelines), roll-on/roll-off facilities, marshalling areas for containers, etc.;

Facilities for water, electricity supply and telephone connexions available to vessels.

19. Another important group of data concerns the handling facilities. A distinction must first be made between the fixed equipment associated with a berth (or a group of berths) such as quay cranes, gantry cranes, conveyor belts, pumps, etc., and the equipment that could be used in various parts of the port such as floating cranes, mobile cranes, forklift trucks, stacking machines, straddle carriers for containers, etc. For each type of equipment, the number of units should be indicated and for each unit, the main technical characteristics, such as capacity, reach, age, etc. Owing to the present trend towards the introduction of modern handling techniques, a continuous record of the changes in cargo-handling equipment is necessary in order to measure the effect of new types of equipment on the over-all port performance.

20. Although berthing and handling facilities are the most significant components of a port, it is useful to record similar information on the following types of equipment:

Storage facilities, classified by types: transit sheds, warehouses, open-air storage, stacking and marshalling areas for containers and vehicles, refrigerated storage, silos, tanks, etc. Each type should be described together with its area or volume and its average capacity determined on the basis of the stowage factor and stacking height of commodities using it. It is also advisable to indicate which storage facilities are associated with a single berth or a group of berths, and which are not. In addition, the type of administration should be indicated for each storage facility (bonded or unbonded, privately or publicly owned or operated).

Transport equipment for use within the port area, i.e. trucks and trailers, lighters (number of units, capacities, ages).

Navigational aid facilities, such as number of pilot boats, number and power of tugs, radio and radar installations, beacons and lights.

Maintenance equipment such as dredgers (number and capacity).

Bunker and water supply facilities.⁶ Number of special berths for bunkering, their characteristics and their pumping facilities. Number and deadweight tonnage of oil tenders for bunkering purposes and their pumping capacities. Storage capacity of bunker oils (if not shared with the storage of oils for local consumption other than bunkering purposes).

Facilities for ships repairs and maintenance.

B. Data on ship traffic

21. This group of data is of vital interest to ports, owing to the high cost of most of the port facilities necessary to receive vessels in the harbour, such as jetties, breakwaters, channels, docks, locks, berths, towage, repairing dockyards, etc. A detailed analysis of the present and likely future ship traffic is needed to provide the most adequate facilities and all ports should maintain complete records of ship traffic.

22. A port is usually visited by a great variety of ships which differ in type, size and flag. In addition, the same ship may call several times a year at one port, and these calls will frequently differ as to the origin and destination, the type of operations, the nature and volume of cargo carried to or from that port. It may therefore be useful to record a large amount of information on the ship traffic. In paragraphs 23 to 25 below, the information which all ports might need is indicated; the need to collect the further information suggested in paragraphs 26 to 27 will depend on the requirements of each individual port.

23. Ships may be classified according to their types of operation. The following classification of ships may be suggested:

Passenger ships,⁷ which do not carry any cargo, except baggage and passengers' cars.

Break-bulk general cargo ships in liner service, which sail at regular intervals between a fixed number of ports and are designed for carrying all types of general cargo. In some cases, cargo liners are also used for the transport of a limited number of passengers.

Tramp ships, which are designed to carry the most common types of cargo on any sea-route. They are

⁶ Obtaining these supplies is sometimes a cause of additional delay for ships. This is the case, for instance, when a ship is obliged to move to a specific berth for bunker. It should also be remembered that good servicing is a factor influencing the reputation of the port.

⁷ Cruise ships can be recorded separately, if it is considered necessary, e.g. for tourism statistics.

generally not used for the transport of passengers or only in negligible numbers.

Specialized ships, which may or may not be operated on a liner basis (e.g. container ships, roll-on/roll-off ships). Within this category it is possible to distinguish:

Tankers;

Gas carriers;

Bulk carriers, which can carry one or several bulk commodities (e.g. oil/bulk/ore carriers (OBO ships)). It may also happen that a tanker calls at the port with a shipment of dry-bulk cargo. In this case, it must be recorded as a bulk carrier;

Lift-on/lift-off container ships;

Specialized ships for the transport of palletized cargo (with side-doors);

Roll-on/roll-off ships, which carry unit loads as vehicles (with or without load). On many routes, these ships are also used for the transport of passengers travelling with their cars;

Barge-carrying vessels.

In some cases it may be difficult to specify under which item of the above classification a ship should be recorded. Whatever the classification used, it should reflect the traffic of ships visiting the port, and the interests of the port.

24. Within each type, the ships may then be differentiated by their size, which may be expressed by various measurements, such as the gross registered tonnage (GRT), the net registered tonnage (NRT), the deadweight tonnage (DWT), and the physical dimensions (length, beam and draught of the hull). All these characteristics are of interest to a port authority. What is essential is for the tonnage of each ship visiting the port to be registered, preferably in DWT and in either GRT or NRT. However, if it is not possible to record more than one tonnage measurement, the fact that there is an approximate correlation between them may prove sufficient from a statistical point of view. The GRT gives the volume of all enclosed spaces of a ship,⁸ while the NRT is derived from gross tonnage by the deduction of space allowed for navigation, machinery and crew accommodation. In most ports, only one of these two measurements is recorded, the choice being related to the system of port charging. The DWT is the weight of goods (including bunkers, stores, water etc.), that a vessel can carry when fully loaded. This measure is extremely significant because, when taken together with other factors such as stowage factor, load factor, cargo for other ports, it makes it possible to estimate the number of ships which are necessary to carry a determined amount of traffic to or from the port. The length and draught of ships are useful because they determine the physical characteristics of berths and many other port facilities such as depths and width of channels, dimensions of locks, turning basins, etc. The values to be recorded are the over-all length and the draught when the ship is fully loaded. The information on the

beam of ships is relevant in connexion with the determination of the reach of shore cranes or bulk handling equipment. Of these three physical characteristics of size, the most useful for the port is the length of ships (which is used in the calculation of the rate of berth occupancy); the draught and the beam can, if needed, be easily derived from this with reasonable accuracy for each type of vessel.

25. The ships visiting the port should also be classified according to the type of operation performed during their visit. It is possible to make a distinction between the following main types of operation:

Loading operations only;

Discharging operations only;

Both loading and discharging operations;

Bunkering;

Repairs and maintenance;

Other purposes (passengers only, storms, etc.).

It is important to bear in mind that the analysis of ship traffic is difficult unless ships carrying cargo and ships in ballast are recorded separately; therefore, all statistics of entrances and clearance should distinguish between these two.

26. Another useful piece of information about a ship is its flag. Although a classification of ships by flag is not essential as far as port operations or port facilities are concerned, many port authorities produce it, especially to assess the share of the national flag in the over-all ship traffic and for the purpose of general shipping policies.

27. It could also be useful to record for each ship the port at which her voyage began and the port of destination, in order to analyse the main shipping connexions of the ports. For the ships operated on a tramp basis, the ports of loading and discharging only would be recorded. For the ships operated on a liner basis, it is preferable to identify each service by recording all ports at which the ship calls. It is not essential for a port to record these data, but their collection could be useful, for example, for consultation and negotiation with liner conferences since the characteristics of the ships visiting the port may be influenced by the conditions prevailing in other ports which may be less efficient.

C. Data on port operations

28. The purpose of data on port operations is to show how the port system reacts when activated by traffic and to make possible various measurements of the port performance.

29. The first concern should be to record the essential information on the turn-around time of ships. For each call of a ship, at least the following should be recorded:

Date and time of arrival at the port;

Date and time of berthing;

Date and time of departure from the port.

When a more detailed analysis of the ship's call is needed (pilotage, towage, loading and unloading time, internal

⁸ 1 ton = 100 cubic feet.

movements of ships) the investigation is best made on a sample of ships during a limited period of time, since the sample can be chosen so as to throw light on the precise factors which it is desired to investigate.

30. In addition, most ports will find it useful to record the various berths visited by the same ship in the port, and the stoppages occurring during the handling work, with their duration and their causes (for example: breakdown of handling equipment, lack of export cargo, weather conditions, labour disputes, etc.). In the same way, the reasons for waiting time of ships should be indicated (berth not available, lack of pilot, lack of tugs, tidal conditions etc.). These data are the basis of many studies concerning the optimum number of berths required, the identification of bottlenecks, the rules of priorities to be observed, and so are most important when a port is facing problems in handling the flow of ships and cargo.

31. During the stay of each ship, it may be useful to record the various services and means provided by the port:

Pilot and pilot boats for each movement of the ship (arrival, departure, transfers from one berth to another);

Number of tugs for each movement;

Successive berths allocated to the ship;

For each working period, specified as normal working time or overtime, the handling equipment and labour used by the ship should be indicated, number of cranes, forklift trucks, lighters, manpower in holds and on shore, etc. It is also useful to record the number of hatches worked, and the gear provided by the ship itself, such as deck cranes, derricks, etc.

These data are essential for the analysis of the efficiency of each type of equipment, individually considered. When it is difficult to record them on a permanent basis, a sampling investigation can be used; indeed this may be more effective and less costly than continuously recording such data.

32. It is important to record operational data on the movement of goods in the port area. In this respect, in each unit of transit and storage (transit shed, warehouse, cold storage, etc.) the following data may be recorded for each working period:

Amount and type⁹ of goods received from ships;

Amount and type of goods received from inland;

Amount and type of goods dispatched to ships;

Amount and type of goods dispatched inland;

Equipment and labour used: number of forklift trucks, stacking machines, gangs, etc.

These data make possible a permanent control of the quantity of goods held in the port. The average number of days spent by the cargo in transit and storage should also be recorded as an important factor in determining the real storage capacity of the port.

33. It is also considered to be in the interests of the port to compile information concerning accidents within its precincts. The information should refer to accidents to ships and damage to cargoes either on board during the loading/discharging or on shore when in storage. The information should allow conclusions to be drawn as to the adequacy of the port facilities for the safety of ships and cargoes, the existence of adequate fire protection and fire extinction, and the degree of safety and protection of the harbour, its approaches and its anchorages in respect of weather conditions. Such information would help to establish the safety image of the port which is essential for avoiding arbitrary impositions of insurance premiums or surcharges.

D. Data on cargo flows and passenger traffic

34. This fourth category of data is traditionally established in all ports because it immediately gives a picture of the port activity and of changes in the level of this activity from month to month and from year to year. These data should be collected in such a way that a detailed analysis of the movements of goods could be undertaken. This analysis is essential for the establishment of cargo forecasts and the identification of the additional facilities needed to cope with the composition and seasonality of existing and future traffic.

35. A first step in the classification is to differentiate between cargoes loaded and those discharged. This distinction shows whether or not the inward and outward traffic of a port is balanced, which affects the general pattern of ships' traffic, and hence the port facilities required. A third group concerns the trans-shipment cargoes. Since this operation includes both discharging and loading of the same cargo, it seems logical to record this cargo separately.

36. The cargo handled may then be classified according to the type of trade. The main types encountered are:¹⁰

Foreign traffic, that is, traffic between ports in two different countries, with the inward movements of goods termed "imports" and the outward movements termed "exports", both movements comprising the country's foreign trade. Foreign traffic may be subdivided, according to the length of sea voyage involved, into ocean traffic and near-sea traffic.

Domestic traffic, that is the traffic between different ports in the same country, normally but not always on the same coastline. Domestic traffic may be subdivided according to the different islands, different administrative regions or different States which are involved.

Transit traffic, that is, traffic physically passing through a port in one country (without entering into that country's foreign trade) having originated in a second foreign country, and being consigned to a

⁹ For the classification of goods by type, see below, paras. 40-41.

¹⁰ To ensure the comparability of statistics of different ports, it is important to treat separately certain traffics such as bunkers, sand and gravel dredged up from an estuary or the sea and brought ashore for sale, fresh fish, supplies and water for ships, etc.

third foreign country. The transit traffic may leave the country from the same port or from a different port or point, either by sea or by another mode of transport (rail, canal, road, pipeline or air).

Entrepôt or re-export traffic, that is traffic which (a) moves into and out of a port or part of a port which has been demarcated as a customs-free zone or (b) is imported with the declared intention of being re-exported, usually after minor operations such as packaging, blending, drying, sorting, etc., which leave the goods essentially unchanged.

Although all these types of traffic do not exist together in all ports, the classification must be such as to enable the various types of traffic to be recorded separately, because the variations in each of them are determined by different factors, and they in turn determine future port needs. This distinction is therefore useful in relation to the studies on cargo forecasting and identification of trends. It should also be noted that each type of traffic may be carried by different types of ships, and may be handled in different parts of the port. These two points show the importance of having separate forecasts for each type of traffic in relation, for instance, to the study of port expansion schemes.

37. Further classification can be made according to the origin and destination of goods. A first breakdown is to classify the goods by country of origin and destination, which in many cases is sufficient to describe the pattern of the port traffic. A more sophisticated classification is by ports of loading and discharge. This second breakdown is useful, especially when the port is connected to another country by several ports very distant from one another (for example, ports on the West and East Coasts of the United States). The origin and destination of goods is useful in connexion with cargo forecasting (especially to determine specific trends in trades to and from various geographical areas) and also because the sailing distance is one factor influencing the ship's size and the transportation cost.

38. Knowledge of origins and destinations in the port hinterland is of interest firstly to define the limits of this hinterland. This is especially important where two, or several, ports are competing in the same hinterland. In addition, these data are useful to identify which means of inland transport are needed in connexion with the port activity.

39. Another classification concerns precisely the types of inland transport used by the port traffic. Distinction should be made between road transport, railway transport, pipeline, inland water transport and coastal ships (feeder services). The purpose of these data is primarily to make possible the best adjustment between the various inland networks (road, rail, inland water) and the port transport network, including the means used to transfer the goods to and from the inland transport vehicles.

40. It is then useful to classify goods according to the mode of transfer from ships to inland transport and *vice versa*. For the inward traffic such a classification could include the following:

Direct transfer from ships to inland transport vehicles;¹¹

Transfer from ship to (1) port storage to (2) inland transport vehicles;

Transfer from ship to (1) lighter to (2) inland transport vehicles;

Transfer from ship to (1) lighter to (2) port storage (and thereafter) to inland transport vehicles.

A similar classification applies for outward traffic. These data are useful to determine the optimum storage capacity and the optimum fleet of lighters to be provided by the port.

41. For the same purpose, the goods which are stored in the port can usefully be broken down, depending on the various types of storage used; indoor storage, open storage, refrigerated storage, silos, tanks, etc.

42. None of the classifications suggested in the previous paragraphs take into account the nature of goods. From an operational point of view, knowledge of the nature of the goods is less important for the port than knowledge of the type of packaging. There is no major difference between handling a ton of cement in bags and handling a ton of sugar in bags. But there is a very great difference between handling a ton of wheat in bags and the same ton of wheat in bulk. That does not mean that the usual classification of goods by nature, which is produced in many ports, is not useful, because these data provide a necessary picture of the commercial activity of the port. In addition they are used for the establishment of cargo forecasts. However, a port classification should be based on a very simple nomenclature, including only those components of the traffic which represent at least 1 per cent of the total traffic, or those which require specific port facilities (dangerous goods, for instance).

43. It is important to bear in mind that a port classification of goods should make possible comparisons, not only with other ports in the same country and in foreign countries, but also with other kinds of transport such as road, railway, air, inland water transport. This should be emphasized at the time when intermodal transport is rapidly developing. A way to achieve this objective is to relate port classifications to broader international classifications such as the Revised Standard International Trade Classification (SITC, Revised), by using the main divisions of such classifications. Many considerations will affect the choice of a port nomenclature of goods, including any classification already in use in the port for charging purposes. However, every effort should be made to obtain the highest level of comparability.

44. It has already been stated that the type of package of goods is even more important to record than their nature, because it is directly relevant to the handling method and handling equipment to be used. In this

¹¹ Direct transfer from ship to inland transport may appear to avoid unnecessary double handling; however, with the exception of certain sophisticated bulk cargo handling arrangements, this practice may delay vessel operations. The vessel is usually the most costly unit in the transport chain.

respect it is possible to make a distinction between the following main types of package:

- (1) Liquids in bulk;
- (2) Solids in bulk;
- (3) Drums;
- (4) Bags;
- (5) Rolls;
- (6) Bales;
- (7) Boxes;
- (8) Barrels;
- (9) Unpacked vehicles;
- (10) Heavy loads (e.g. machinery, equipment for transport);
- (11) Bulky goods (e.g. rails, timber in logs);
- (12) Fragile goods (e.g. fresh fruits, glassware);
- (13) Palletized goods;
- (14) Containers;
- (15) Other packaging.

The above list is given only as an example and each port should set up its own nomenclature, taking into consideration the specific structure of its traffic and the various handling methods used by the port. These data are essential for determining the best types of handling for the port to provide.

45. In some ports it is useful to have information about the value of goods. These data are required, for instance, when the time-cost of goods during their stay in the port area has to be calculated. It may also be useful to compare the average port cost per ton of cargo handled with the average value per ton of cargo. This value should be the f.o.b. value for exported goods and the c.i.f. value for imported goods. These data are usually obtained from the Customs statistics.

46. There is finally the question of the choice between weight and volume in the recording process. For most commodities, it appears that the weight is the more significant characteristic to be recorded in a port, because it has the strongest influence on the design and capacity of the handling and transport equipment. (The figure which should be recorded is the gross weight, i.e. including packaging.) The volume, in the sense of the number of cubic feet of a commodity, is more likely to be useful for shipping purposes than for ports, because the number of occasions when the cubic volume of cargo imposes any limitation on a port's capacity must surely be rare. Nevertheless, it is sometimes useful to record the volume when low density goods are concerned (wool, cotton, sisal, etc.) because the space requirement in transit sheds may become more important than the weight itself. However, it is usually possible to derive one characteristic from the other through the stowage factor. In some cases, it is necessary to specify the cargoes by number of pieces (e.g. live animals, unit loads such as cars, containers, etc.) but this does not exclude indicating their weight. When several sizes of containers are used, it is important to indicate separately the number included in each group.

47. Finally, the number of passengers who embark and disembark at the port may be recorded in the following categories:

(1) <i>Nationals or citizens</i>	(2) <i>Foreigners</i>
Disembarked	Disembarked
Embarked	Embarked
	In transit
	Tourists
	Pilgrims

E. Data on port labour

48. In connexion with port operation, these data are useful:

(a) For formulation of a labour policy and for making possible improvements based on work study techniques;

(b) For calculation of the port costs per unit of cargo. For each working period, specified as normal working hours, overtime, Sundays and holidays, the personnel participating in the port activity should be carefully recorded by category:

- Supervisory staff;
- Administrative and clerical staff;
- Crane drivers;
- Truck drivers;
- Dock workers, etc.

If necessary, a record can be made separately either for each sector of the port, when these sectors are operated independently (e.g. oil sector, bulk sector, general cargo sector) or for each operational unit (e.g. handling units, storage units, harbour master unit, etc.). In large ports, both classifications should be applied. In any case, a distinction should be made between permanent, temporary and casual labour. For each working period, the labour supply should be compared with the labour force required by ships and other port users, in order to facilitate the best adjustment between the supply and the demand of port labour. A record should also be kept of strikes and their duration, with an indication of the number of man-days lost per month and per year.

F. Data on costs and revenues

49. These data are of crucial importance for the port management. Although the port costs are appraised by the port users in terms of level of port charges and tariffs of services provided by the port, these elements should be related to the investment costs, operating and maintenance costs of port facilities and services. As a result, no port policy can be properly defined unless a number of relevant cost data are available.

50. The cost data produced by the port should, in particular, provide information on those individual port activities which are profitable and those which are not, thus making it possible to:

- Appraise the profitability of port investments;
- Establish a pricing policy in relation to the cost of providing the services; and
- Constitute an element in formation of a policy for the wages and salaries of port labour.

51. To this end, the port accounting system should be such as to produce, for each unit of investment in port:

The capital cost

The associated cost of capital (interest, repayment of loans)

The annual depreciation rate and absolute amount

The operating costs (labour costs, overheads)

The maintenance costs (labour costs, supplies).

On the other hand, earnings which are related to individual items of the port tariff should be recorded separately for each item.

52. Special attention should be paid to the data concerning the cost of port labour. These costs should be compiled separately for each category of labour, and, within each category, for each item of remuneration, such as gross wages and salaries, payments for overtime, Saturday and Sunday work, tonnage bonuses, social security costs and other related costs (e.g. eating facilities, food, recreation). These data should enable the port authority to measure the budgetary impact of any change in the wage and salaries system and to measure the effects of overtime, night shifts and Saturday and Sunday work on the total port costs.

G. Other data

53. In addition to the types of data described so far, it happens frequently that the port needs other types of information which, although not produced by the port itself, are sometimes important in connexion with specific studies. It seems that the most important data concern foreign ports, the world merchant fleet, the cost of ships, freight rates, and information on the total trade of the country and projections of the future growth. This information is not of the type which a port itself collects; it is reference material which should be available for use when needed.

54. Information about other ports is extremely valuable for port authorities, especially for ports of similar size having not too different cargo composition. It is possible, for instance, to gain an insight into the trends of port layout and new handling facilities from the expansion scheme of other ports. These data may also be used to compare in different ports significant ratios such as the annual tonnage per metre of quay, the rate of berth occupancy, etc., and to seek the causes of differences. Comparison of the pricing system with the systems in use in other ports in either developed or developing countries may also be extremely useful. For these reasons, it seems that a broad exchange of statistical data (including operational data) from port to port, which is not presently practised on a large scale, should be encouraged. This exchange is essential between ports in the same country. In due course, UNCTAD may undertake the publication of comparable statistical data on ports in selected countries.

55. The ship traffic of a port is determined by the evolution of the world merchant fleet. When a new type of ship appears, it exercises a pressure at first on a small number of ports which are obliged to adjust their facilities to the new design. The same pressure then spreads to an increasing number of ports, when a growing number of ships of the new type enter service replacing the obsolete ships. A port authority can improve its forecasts of future shipping traffic if it maintains an awareness (for example, through watching developments recorded in shipping journals) of the changing size and composition of the world fleet.

56. Many economic calculations in connexion with port and shipping studies need the knowledge of the time-cost of ships. For this purpose, the time spent by each ship during its call is obtainable from port records, but the cost of a ship per day must come from outside sources. It cannot be obtained for each individual ship visiting the port. However, it may be possible to calculate a set of average values for each type and size of ship using the port from published data if the shipowners do not provide them directly. Alternatively and better, average values may be obtainable for a sample of ships using the port, and readjusted at regular intervals.

57. The last interesting item of information concerns the level of freight rates applied to the goods carried to and from the port. A significant fraction of the shipping cost which has to be covered by freight rates is represented by cost occurring in ports. This influence appears clearly when a shipping conference decides to apply a freight surcharge for goods carried to and from a congested port. In the tramp sector, the same influence is shown through demurrage. Despite this evident and meaningful correlation, there are few ports which have information on the freight rates applied for the port. This can mainly be explained by the difficulty in obtaining the relevant information, which is frequently regarded as confidential by shipowners and shippers. However, such knowledge would be extremely useful for examining the impact of port improvement on the level of freight rates, the discrepancies between rates used on similar routes and in assessing whether the application of surcharges (and their values) are justified.

58. Of the information discussed in this chapter, some is absolutely essential for all ports to collect and maintain, both for their own internal purposes and to contribute to the total of world data on ports which enables ports to compare their activities and to measure their efficiency against other ports. The tabulation which follows lists each item of information according to whether it is part of the minimum essential to be recorded, whether it is important but not essential and lastly whether it is useful but neither essential nor important. A port setting up an information system, or improving an existing system, might find it useful to work out the essential data and then, as resources permit or needs demand, add first the important data and then the useful data.

Classification of port data and information

Main categories of data	Recording		Nature	Frequency of collection
	Essential	Important		
<i>Port organization</i>	List of individual port operators Description of their functions		Information	Annual
<i>Port facilities</i>				
Berths	Classification by type Depth of water alongside berth Physical description		Information	Annual
Handling equipment	Classification by type Technical characteristics Capacity Age		Information	Annual
Storage equipment	Classification by type Physical description Storage capacity		Information	Annual
Transport equipment for use within the port area	Transport infrastructure (road- rail-inland water) Classification of vehicles by type Technical characteristics Capacity Age		Information	Annual
Navigational aids		Signalling system Pilotage Towage	Information	Annual
Servicing of ships		Facilities for : Bunker supplies Water supplies Repairs and maintenance	Information	Annual
<i>Ship traffic</i>				
Type of ship	Passenger ship Break-bulk general Cargo ships : Liners Tramps Specialized ship Mixed ship		Statistical	Continuous

Size of ship	GRT or NRT DWT Length	Draught	Beam	Statistical	Continuous or sampling
Type of operation	Loading Discharging Loading and discharging Bunkering Repairs, maintenance Other purposes			Statistical	Continuous
Origin and destination of ship		By country of origin and destination	By port of origin and destination	Statistical	Continuous or sampling
Flag of the ship			Flag	Statistical	Continuous
<i>Port operations</i>				Statistical	Continuous
Turn-around time of ship	Times of : Arrival Berthing Departure				
Services and facilities provided by the port	Successive berths allocated to each ship Handling and transport equipment for each working period Amount of cargo loaded and discharged during each working period			Statistical	Continuous or sampling
Goods in storage		Pilot and craft at each movement No. of tugs at each movement		Statistical	Continuous or sampling
Supplies to ship		For each unit of storage : Goods received from ships Goods dispatched to hinterland Goods received from hinterlands Goods dispatched to ships		Statistical	Continuous or sampling
Accidents		Types and tonnages of bunker Tonnages of water Accidents to ships Damage to cargoes		Statistical Information	Continuous Continuous

Classification of port data and information (continued)

Main categories of data	Recording		Useful	Nature	Frequency of collection
	Essential	Important			
<i>Port labour</i>					
For the whole port :			Classification by age	Information	Weekly or monthly
No. of supervisory staff					
No. of clerical staff					
No. of permanent dock-workers					
Average number of casual workers					
At each working period (normal-over-time-holidays) :		The same breakdown by ship	Record of absences by cause	Statistical	Continuous
Number of supervisory staff					
Number of clerical staff					
Number of permanent dock-workers					
Number of casual workers					
<i>Cargo flows</i>					
Type of traffic				Statistical	Continuous
Goods discharged		Ocean traffic			
Goods loaded		Near-sea traffic			
Goods trans-shipped					
Types of traffic :					
Foreign					
Domestic					
Transit					
Entrepôt					
Commodities				Statistical	Continuous
Amount of cargo in each class of the port commodity classification					
Type of packaging				Statistical	Continuous
Amount of cargo in each type of packaging					
Size of shipment				Statistical	Sampling
Number of individual shipments in each class size					
Type of operation				Statistical	Continuous or sampling
Transfer from ships to inland transport and vice versa for inward and outward traffic					
Direct					
Through port storage					
Through lighter					
Through lighter and storage					

Type of inland transport	Amount of cargo received and dispatched : By rail By road By inland water transport	Statistical	Continuous
Origin and destination	Countries of origin and destination Ports of loading and discharging Port hinterland origin and destination f.o.b. value for exported goods c.i.f. value for imported goods	Statistical Statistical	Continuous Sampling
Passenger traffic	Disembarking Embarking Nationals Foreigners Transit Tourists Pilgrims	Statistical	Continuous
Port costs and revenues Port costs	By main facilities : Investment costs Interest Depreciation Operating costs Maintenance costs	Statistical	Annual
Labour costs	Personnel costs : By categories of labour By items of remuneration	Statistical	Annual
Revenues	Revenues by item of port tariff	Statistical	Annual
Other data On other ports	Significant ratios comparison such as : Berth occupancy Annual tonnage per metre of quay Average turn-around time for 1000 tons of cargo	Information	Annual
World fleet	Port tariffs and pricing systems Port expansion schemes Composition-age Trends in ship designs Average time-cost of ship (by type and size of ship)	Information	Annual
Freight rates	Level of freight rates for main commodities carried to and from the port on specific routes	Statistical	Sampling

Chapter III

COLLECTION AND PRESENTATION OF PORT STATISTICS

59. In chapter II, the various kinds of data which a port may usefully compile have been described. The present chapter deals with the question of how to collect these data, in order to avoid unnecessary clerical work and to facilitate their further processing as well as the presentation of statistical results.

A. Sources of data

60. Once the data requirements have been assessed by the port authority, the problem is to identify the possible sources of these data. Many of them are produced by the port itself for operational or for charging purposes in connexion with its regular activity. Frequently, this information is stored, but is not used as statistical material with a view to improving port operations and port planning. Other data have to be sought outside the port. The problem is therefore to identify which data are available and where, and to compare the results of this investigation with the data requirements. When essential data are not recorded anywhere, appropriate action must be taken to make them available. But the simultaneous production of the same or similar data in several sections of the port should if possible be avoided. It is also useless for the port to record data which can easily be obtained from other sources, such as Customs, railways, maritime administration, Ministry of Transport, etc.

61. The port itself is the principal source of data. The technical or engineering branch can provide information on port facilities (the number of units, main technical characteristics and capacities). The traffic and commercial branch should be able to provide data concerning the mode of transfer of goods between ship and inland transport, the type of port storage used by the cargo, the type of packaging, the purposes of ships' visits, the duration and causes of work stoppages, the various equipment allocated to ships and to storage areas, the movements of goods to and from port storage and the port supplies to ships. The personnel branch is the source of data on port labour. The harbour master's office, in most ports, keeps records of all ship movements and sometimes of the causes of delays. Supplementary information can be obtained from the pilotage and towage services. The accounting branch is the major source of cost and revenue data, but can also provide a number of useful data on port operations.

62. Access to the internal sources of data is sometimes difficult when port activities are divided between several authorities or organizations, operating more or less independently of one another. This is the case, for

instance, when the cargo handling work is performed by private stevedoring firms. Each of them is a source of data. But these data may be produced in forms quite different from what is required by port authorities, and this makes their integration at the port level difficult.

63. Another difficulty arises when the branches of the port do not produce the data with the degree of detail which is needed for further analyses. This is the case, for instance, when the traffic branch does not record separately the cargo handled during normal working hours and in overtime. In some cases, the information which is lacking may be found in another branch of the port. In such a case, it may be possible to obtain the data from the accounting branch, because higher rates are charged for goods handled during overtime. This example shows that before requesting a port unit to produce a new type of information, which could be time consuming, it is necessary to enquire whether or not this information already exists elsewhere.

64. Many other data of interest for port statistics are, however, obtained from external sources. Some organizations produce interesting data for their normal activity and can be regarded as alternative sources of data. For instance, the Customs administration can provide data on the cargo traffic by volume (tons), data on the value of goods and data on the countries of origin and destination. However, before deciding to rely on such external sources, one should ascertain how far their data are comparable with those produced by the port. Where data from different sources are not comparable, every effort needs to be made to secure the collection on a comparable basis before establishing several systems of data collection.

65. As far as ships are concerned, the ship manifest appears to be the most useful document for statistical purposes, because it contains information about :

The ship (name, flag);

The origin and destination of ships and cargoes; for the goods discharged, there is a manifest for each port of loading and, for the goods loaded, there is a manifest for each port of dischargement;

The total amount of cargo loaded and discharged (in terms of weight or volume);

The nature of goods, all individual shipments being listed in the manifest;

The manifest includes also the freight rate charged for each unit of cargo.¹²

¹² The part of the ship manifest containing the freight rate is sometimes removed before it is given to port authorities.

66. The manifest does not always enable the ship type to be identified. This is not difficult in the case of specialized ships, because they can be identified by the type of cargo carried. It is more difficult when one wants to make a distinction between liner and tramp ship. Generally, the ships owned by members of conferences are well known to the port authority; but additional ships may be chartered by the conference lines. In addition, the liner ships operating outside the conference may be confused with tramp ships. This kind of information is usually provided by the ship agent.

67. The technical characteristics of the ship (tonnage, length, draught) are in most cases requested by the harbour master before the ship's arrival. They are recorded on an entry form which is filled in by the ship agent. These characteristics may be checked and eventually completed with the help of the registers of the important classification societies (Lloyd's Register of Shipping, American Register of Shipping, Bureau Veritas, Norske Veritas, etc.). These registers contain up-to-date information on practically all ships in active service in the world.

68. Information relating to the different types of inland transport is not always available. This is particularly the case for road transport, which frequently includes a large number of independent carriers. Usually, the railways and inland water transport operators keep good statistics.

69. The sources for general reference material on, for example, foreign ports, the world merchant fleet, time-cost of ships, are varied. It is advisable for a port authority to establish contacts with other ports, with research institutions and with any other bodies which disseminate useful information. In this way, a great deal of basic reference material can be gathered through the exchange of publications.

B. Method of collection

70. The practical method of data collection will depend on:

- (a) The size of the port traffic;
- (b) Its composition (small or large numbers of commodity types);
- (c) The degree of sophistication of calculations which are to be made from the port statistics;
- (d) Availability of qualified staff.

71. In ports with a small volume of traffic, or whose traffic is composed only of a small number of commodity types, the simple method of keeping a number of register books by hand may be quite satisfactory. In the first case, the number of figures for each type of data is small and even sophisticated calculations can easily be made. In the second case, the number of separate classes is small, and the calculations will therefore be simple. Annex I contains some examples of forms which may be used for such registers. The use of simple calculating machines (addition-subtraction-multiplication and division) makes it easier to process the data recorded in this way.

72. When the volume of port data is too large to be collected and recorded by hand in register books, a system of cards has to be adopted. These may be entered by hand for manual sorting or may be punched on cards of specific type for mechanical sorting of varying degrees of sophistication, or for use with electronic equipment. Because of its speed and accuracy, particularly in producing data for analysis, it is usually preferable to make use of electronic equipment once the volume of data grows beyond that which can be handled by mechanical means, if spare capacity in equipment installed by the port authority, but not fully utilized by it, is available in the country.

73. In this case, data should be recorded on punched cards which are the main type of input for most electronic equipment. To this end, it is necessary to build up a code for the various types of data. A code is a numerical symbol which uniquely defines one specific piece of information, as illustrated by the following examples:

Code	Information	Code	Information
1	Inland road transport	1	First shift
2	Inland rail transport	2	Second shift
3	Inland water transport	3	Overtime
		4	Saturday shift

The collection of data is done by indicating on a specific form the code number corresponding to the various items of information to be recorded.

74. In practice, a separate form may be used for each ship call, which will contain:

- (a) Information on the ship:
 - Name (in letters);
 - Flag (code);
 - Type (code);
 - Registration number (chronological or Lloyd's Code number of ship);
 - Gross registered tonnage;
 - Deadweight tonnage;
 - Over-all length;
 - Draught;
 - Port of origin (code);
 - Port of destination (code);
 - Sea route (code) (for liner ships only).
- (b) Information on the cargo discharged and loaded:
 - Weight of goods discharged;
 - Weight of goods loaded;
 - For each type of cargo (code):
 - Weight discharged;
 - Weight loaded;
 - Type of packaging (code);
 - Berth of loading/discharging (code);
 - Ports of loading/discharging (code);
 - Type of transfer to/from inland transport means (code);
 - Type of storage (code).

- (c) Information on port services:
- Time and date of ship arrival;
 - Time and date of berthing and code for the first berth;
 - Time and date of transfer to another berth and code of the second berth;
 - Time and date of transfer to further berths;
 - Time and date of ship departure;
 - For each shift worked (code):
 - Date (day and month);
 - Berth (code);
 - Effective duration of work;
 - Reasons for delay (code);
 - Weight of goods discharged;
 - Weight of goods loaded;
 - Number of hatches worked;
 - Number of cranes used;
 - Number of gangs allocated to the ship;
 - Other equipment—type (code) and number.

The position of the various codes on the form should correspond as far as possible to the lay-out of cards which will be punched from it. Examples of such forms are given in annex I below.

75. The main codes to be defined in connexion with port statistics are the following:

- Code of ship identification: for instance two digits to specify the flag, one digit to specify the type, and four digits to specify the n^{th} ship of the same flag received in the port since the beginning of the codification. When a ship visits the port for the first time her technical characteristics are recorded and punched into a card. For further visits, it will be sufficient to indicate the code of identification and the other characteristics will automatically be available;
- Code specifying the various positions that a ship can occupy during the visit: anchorage points, berths. When the port includes several parts concerned with different types of traffic, each part will be specified by an additional digit;
- Code specifying the sea routes;
- Code specifying the ports of the world: for instance a five digit code makes it possible to specify the region with one digit, the country with two digits, and individual ports with the last two digits.
- Code specifying the different types of working period (normal shifts, overtime, Sundays, holidays).
- Code specifying each item of the nomenclature of goods.
- Code specifying the type of package.
- Code specifying the main causes of waiting time.
- Code specifying the type of transfer to/from inland transport means.
- Code specifying the type of storage.

Any system of coding must be carefully thought out at the outset, because it is not advisable to introduce new code numbers if it is desirable to be able to make comparisons through time.

76. The data collected in this way should obviously be carefully stored in order to make possible their retrieval at any time they are needed for processing. This means that the data have to be grouped according to their type, and in chronological order.

C. Organization of data collection

77. The first condition in this respect seems to be the existence within the port of a centralized statistical unit gathering information on all aspects of the port activity. In too many ports, the required information does exist but is scattered in various parts of the port; each operational unit holds its own statistics and does not see the necessity of making this information available to other sectors of the port. This practice makes it difficult to analyse the functioning of the port as a whole. Sometimes the private firms operating within the port, like stevedoring firms or stowage companies, are reluctant to reveal figures that they consider as commercial in nature. It is, however, obvious that the level of productivity achieved by these firms determines to a large extent the amount of facilities that the port authority is required to provide. It is therefore essential for the port authority to assess this level of productivity and to get the information needed for this purpose.

78. When a country has several ports, a statistical unit should be organized in each port. It may be, however, that two or three ports, located for instance on the same estuary, are under the control of a single authority. In this case, it may be advisable to have a common statistical unit, because the various ports are operated as parts of an integrated system, and also because the sources of data are not too far from the statistical unit. In some countries, the data collected in each port are processed by a national statistical unit. But even in this case, it is important to maintain in each port a statistical unit to ensure that the data are collected in the appropriate way.

79. The statistical unit of a port should work in close co-operation with the port units which use port statistics (economic division, operational division, research and planning, etc.). These units express their needs and the statistical unit has to collect the corresponding data in such a way that they can easily be used in further calculation. When a change occurs in the method of data collection (e.g. introduction of the use of electronic equipment) it is essential to ensure a continuity between the new method and the previous one. If the two systems produce data which are not strictly comparable then there should be a period of overlap during which both systems are in use.

80. Although it is difficult to assess the optimal size of a statistical unit, it can be said that in a sample of six ports extremely different from one another in their size and in the sophistication of processes used, the number of people concerned with port statistics varied from 8 to 20 men. In all cases, approximately 25 per cent are qualified statisticians and the remainder are clerical staff. The actual requirements for any port will clearly depend on the volume of statistical data to be collected and the

methods to be used. On the basis of this small sample which does, however, cover two of the world's largest ports in addition to two ports in developing countries, it is unlikely that a port would find the manpower requirements excessive.

D. Presentation of port statistics and information

81. From the crude data which have been collected, it is possible to derive a number of statistical returns to be issued at appropriate intervals and under a specific form of presentation. In some cases, the figures recorded

on a continuous basis are simply added to obtain aggregated figures for various periods of time (week-month-year). More frequently, two or more types of data are put together in such a way that significant ratios can easily be derived. A number of the most important of these are listed in chapter I, paragraph 3, above. Annex II contains a number of draft forms which may be used by port authorities as examples of statistical returns which are important for management purposes. Each port authority will decide which part of the information contained in these tables is of general interest and may be published, and which part should be regarded as confidential for use by the port management.

ANNEXES

ANNEX I
EXAMPLES OF FORMS FOR DATA COLLECTION

A

Data on ship traffic—Example of form which may be used for data collection by hand

Month:

Ship No. ^a	Name of ship	Type of ship ^b	Size of ship ^c	Length of ship	Day and hour of arrival	Day and hour of berthing	Day and hour of departure	Tonnage of goods discharged	Tonnage of goods loaded	Draught of the ship	Port of origin	Port of destination	Flag of ship	Owner of ship
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1														
2														
3														
4														
5														
etc. ^d														

NOTE: Columns (1) to (10) are essential for the port to record.

Columns (11) to (13) are important.

Columns (14) and (15) are useful. (See above, Chap. II, para. 33.)

^a Chronological order of ship arrivals.
^b Break-bulk general cargo, tanker, bulk carriers, specialized, passenger, others.
^c Expressed either in GRT, NRT or DWT.
^d The number of rows in the form will depend on the number of ships to be listed.

B

Data on cargo flows—Example of form which may be used for data collection

Month:	Ship No.	Name of ship	Cargo discharged (tons)							Cargo loaded (tons)											
			Bulk liquid			General cargo				Bulk solid			General cargo								
			1	2	etc. ^a	1	2	3	4	etc. ^a	Total	1	2	etc. ^a	1	2	3	4	etc. ^a	Total	
	1																			
	2																			
	3																			
	4																			
	5																			
	6																			
	etc. ^a																			
	Monthly total																				

^a The number of rows and columns will depend, in each port, on the number of ships to be listed and on the composition of traffic and on the nomenclature of commodities used by the port.

Example of data collection form (for electronic processing)

Specifications		Ship Servicing		Passengers										
				Nationals	Foreigners									
Ship No. ^a	Owner: [letters]	Water: [tons]												
Name: [letters]	Flag: [code]	Bunker		disembarked:	--									
Type ^b : [code]	Port of origin: [code]	Fuel oil: [tons]		embarked:	--									
Size ^c :	Port of destination: [code]	Gas oil: [tons]		transit:	--									
Length:	Route: [code]	Other: [tons]		tourists:	--									
Draught	Conference: [code]													
		<i>Turn-around</i> ^d		Idle time (hours)	Working time (hours)									
1st position : [code]	arrival (month-day-hour)	time spent in 1st position												
2nd position : [code]	transfer (month-day-hour)	time spent in 2nd position												
last position : [code]	transfer (month-day-hour)	etc.												
	transfer (month-day-hour)	time spent in last position												
	departure (month-day-hour)													
<i>Operations (one line by working period)</i>														
Date	Code shift	Code position	Duration of work (hours)	No. of hatches worked	No. of gangs	No. of workers	No. of cranes	No. of forklift trucks	Code type of storage ⁱ	Code type of transfer ^h	Code port of loading/discharge	Tons of cargo	Value of cargo	Freight
<i>Cargo (one line by shipment)</i>														
Commodity	Code packaging	Code position	Discharge/loading ^t	Code type of traffic ^g	Code type of transfer ^h	Code type of storage ⁱ	Code port of loading/discharge	Tons of cargo	Value of cargo	Freight				
^a Chronological order of ships' arrival, or code of Lloyd's Register of Shipping. ^b Break-bulk general cargo, tanker, bulk-carrier, specialized, passenger, others. ^c Expressed either in GRT, NRT or DWT. ^d Example of positions : (a) anchorage, waiting for pilot; (b) berth No. 5; (c) dockyard. • e.g. : 1st shift, 2nd shift, 3rd shift, overtime, holidays. ⁱ Discharging = 1; Loading = 2. ^h Foreign, Domestic, Transit, Entrepôt. ^h Direct Direct through lighter, Stored in port. ⁱ Transit sheds, open storage, solid storage, alios etc.														

ANNEX II
MODELS FOR TABLES OF PORT STATISTICS

A
Berthing facilities

Year:	Berth No.	Length	Draught	Width (apron)	Handling equipment		Transit sheds	Stacking areas	Other facilities	Main traffic
					— Cranes (number-type-lifting capacity)	— Pumps (capacity per hour)				
	Passenger berths								Passenger terminals	
	1									
	2									
	—									
	Break-bulk general cargo berths								Refrigerated stowage	Chemicals Citrus exports
	1									
	2									
	3									
	—									
	Container berths									
	1									
	2									
	—									
	Roll-on/roll-off berths									
	1									
	2									
	—									
	Oil berths								Crude oil petrol	
	1									
	2									
	—									
	Ore berths									Iron ore fertilizers in bulk
	1									
	—									
	Grain berths								Silo	
	1									
	—									
	Cement berths								Silo	
	1									
	—									
	Anchorage points									
	1								×	×
	—								×	×

* x indicates "not applicable".

B
Port equipment chart

Year:

<i>Type of equipment</i>	<i>Technical characteristics and capacity</i>	<i>Average lifetime</i>	<i>Age</i>	<i>Purchasing price</i>	<i>Replacement cost</i>	<i>Annual depreciation</i>
Quay cranes	—	—	—	—	—	—
Mobile cranes	—	—	—	—	—	—
Floating cranes	—	—	—	—	—	—
Forklift trucks	—	—	—	—	—	—
Trucks	—	—	—	—	—	—
Trailers	—	—	—	—	—	—
Lighters	—	—	—	—	—	—
Tugs	—	—	—	—	—	—
Bunker facilities	—	—	—	—	—	—
Repairing facilities	—	—	—	—	—	—
Others	—	—	—	—	—	—

C
Ship traffic

Month:

Type of ship	No. of arrivals	Total GRT or NRT	Total DWT	Average DWT	Total cargo (tons)		Average cargo by ship (tons) ^a	
					Discharged	Loaded	Discharged	Loaded
(a) Liners								
Only discharging								
Only loading								
Discharge and loading								
Other purposes								
Total liners								
(b) Tramps								
Only discharging								
Only loading								
Discharge and loading								
Other purposes								
Total tramps								
(c) Tankers								
Only discharging								
Only loading								
Discharge and loading								
Other purposes								
Total tankers								
(d) Bulk carriers								
Only discharging								
Only loading								
Discharge and loading								
Other purposes								
Total bulk carriers								
TOTAL a + b + c + d								

^a Total cargo divided by the number of ships.

D
Ship traffic—Unit load ships

Month:

Type of ships	No. of arrivals	Total GRT or NRT	Total DWT	Average DWT	Total number of unit loads (containers, vehicles - barges)			Total cargo (tons)		
					Empty	Stuffed	Total	Unlifted	Break-bulk	Total
					Discharge Loaded	Total	Discharge Loaded	Total	Discharge Loaded	Total
(a) Ocean-going ^a										
Container ships										
Only discharging										
Only loading										
Discharge and loading										
Other purposes										
Total full container ships										
(b) Feeder container ships										
Only discharging										
Only loading										
Discharge and loading										
Other purposes										
Total feeder container ships										
(c) Roll-on/roll-off										
Only discharging										
Only loading										
Discharge and loading										
Other purposes										
Total roll-on/roll-off										
(d) LASH										
Only discharging										
Only loading										
Discharge and loading										
Other purposes										
Total LASH										
TOTAL a + b + c + d										

^a These ships sail on trunk lines.

E
Passenger traffic

Month:

	<i>Cruisers</i>	<i>Passenger ships</i>	<i>Roll-on/roll-off</i>	<i>Other ships with passengers</i>	<i>All ships</i>
No. of ships					
Total GRT					
Average GRT					
Disembarked:					
Nationals					
Foreigners					
Total					
Embarked:					
National					
Foreigners					
Total					
In transit					
Tourists					
Pilgrims					
No. of passenger cars:					
Discharged					
Loaded					
Total					

F
Cargo flows by types of traffic
(Tons)

Month:	Cargo discharged										Cargo loaded									
	Type of traffic	Bulk liquid	Bulk dry	General cargo	Total 1	Dispatched by				Total 2	Received by									
						Road	Rail	Water	Pipe-line		Road	Rail	Water	Pipe-line						
	Foreign																			
	Ocean-borne																			
	Near-sea																			
	Domestic																			
	Transit																			
	Re-exportation																			
	TOTAL																			

G

Cargo flows classified by commodities and types of packaging

(Tons)
Labour productivity

Commodities*	Type of packaging						Break-bulk						Unit loads				
	Drums Barrels	Bags	Rolls	Bales	Boxes	Vehicles machinery	Bulky goods	Fragile goods	Others	Pre- strung	Pallets	Roll-on/ roll-off	Con- tainer	LASH	Bulk solid	Bulk liquid	Total
1																	
2																	
3																	
—																	
—																	
TOTAL																	
No. of gang/shifts																	
Throughput per gang/shift																	
No. of men/hours																	
Goods																	
Net ^b																	
Throughput per man/hour																	
Goods																	
Net																	

* According to nomenclature used by the port. ^b Idle time excluded.

H

Turn-around time of ships—ship productivity

Month:

Break-bulk general cargo ship ^a

Classes of cargo volume ^b (tons)	No. of ships	Amount of cargo discharged and loaded (all ships)		Time for all ships (hours)				Average ship time (hours)				Tons per ship hour (including waiting time)		
		Waiting	In port	Waiting	Idle	Working	Total	Waiting	Idle	Working	Total		Tons per ship hour in port	Tons per ship working hour
0- 499														
500- 999														
1,000- 1,999														
2,000- 2,999														
3,000- 4,999														
5,000- 6,999														
7,000- 9,999														
10,000-14,999														
over 15,000														
Ship without cargo														

^a The same table can be used for specialized ships (containers, roll-on/roll-off, bulk carriers etc.).

^b Amount of cargo discharged and loaded by the ship in port.

Analysis of waiting time

Month:

Break-bulk general cargo berths ^a

(1) No. of ships arrivals:

Causes of delays	No. of ships having to wait (2)	Percentage of ships having to wait (3) = (2)/(1)	Duration (ship hours) (4)	Average waiting time per ship net (5) = (4)/(2)	Average waiting time per ship gross (6) = (4)/(1)
(a) Outside the port					
Causes attributable to the ship					
Berth not available					
Pilot not available					
Tug not available					
Tidal constraints					
Weather constraints					
TOTAL (a)					
(b) In the port					
Causes attributable to the ship					
Lack of equipment					
Breakdown of equipment					
Weather constraints					
Lack of export cargo					
Administrative delays					
Strikes					
Others					
TOTAL (b)					
TOTAL (a) + (b)					

^a Similar tables are used for other types of berth.

Berth occupancy and berth throughput

Month:

- (1) No. of hours in the month:
- (2) No. of working hours in the month:

Type of berth	No. of berths ^a (3)	Length of quay (4)	No. of ship hours at berth (5)	No. of ship working hours at berth (6)	Rate of berth occupancy gross (7) = (5) : (1) × (3)	Rate of berth occupancy net (8) = (6) : (2) × (3)	Amount of cargo discharged and loaded (tons) (9)	Throughput per berth (10) = (9) : (3)	Throughput per unit of length of quay (11) = (9) : (4)
Break-bulk general cargo berth									
Specialized berths									
Grain									
Ore									
Oil									
Timber									
Containers									
Etc. ...									

^a Determined as shown in paragraph 14 above.

K

Use of storage facilities

Month:

Types of storage	Import cargo (tons)				Export cargo (tons)							
	Floor area (1)	Average capacity ^a (2)	Rec'd from ship (3)	Delivered (4)	Av. amount in port storage (5)	Av. time spent in storage (6)	Rec'd from Inland (7)	Dispatched to ships (8)	Av. amount in storage (9)	Av. time in storage (10)	Rate of occupancy (11) = (5) + (9) / (2)	Throughput (12) = (3) + (7) / (1)
Transit sheds												
Stacking areas												
Container yards												
Warehouse												
Cold storage												
Silo												
Etc....												

^a Determined on the basis of stowage factors for main types of commodity and the height of stacking.

L
Port labour statistics

Month: _____
Break-bulk general cargo berths

	No. of ships working			Supervisory staff categories ^a			Clerical staff categories ^b			Engine drivers categories ^c			No. of gangs ^d			Dock workers		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	Permanent ^d	Casual ^d	
(a) <i>Week days:</i>																		
1st shift																		
2nd shift																		
3rd shift																		
Overtime																		
TOTAL (a)																		
(b) <i>Saturdays, Sundays and holidays:</i>																		
1st shift																		
2nd shift																		
TOTAL (b)																		
	TOTAL (a) + (b)																	

^a e.g. : cargo superintendents—foremen—winchmen etc.
^b e.g. : tally clerks—shed keepers etc.

^c e.g. : crane drivers—forklift truck drivers—lorry drivers etc.
^d 1 = ships holds; 2 = shore and shed; 3 = delivery gangs.

M

Summary of significant series of data

Year :

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total for Year
No. of ships arrivals :													
General cargo													
Specialized ships													
Size of ships :													
General cargo													
Specialized ships													
Average waiting time per ship :													
General cargo													
Specialized ships													
Rate of berth occupancy :													
General cargo													
Specialized ships													
Amount of cargo discharged (tons) :													
General cargo													
Bulk liquid													
Bulk dry													
Amount of cargo loaded (tons) :													
General cargo													
Bulk liquid													
Bulk dry													
Throughput per berth :													
General cargo													
Bulk liquid													
Bulk dry													
General cargo :													
Throughput per gang/shift													
Throughput per man/hour													