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Port pricing

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Port pricing

Report by the UNCTAD secretariat

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NOTE

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

ACKNOWLEDGEMENTS

In order to obtain information about the various pricing systems applied in ports, questionnaires were sent to a sample of some 114 ports in 106 countries. The UNCTAD secretariat is grateful to the 81 port authorities which co-operated by answering these questionnaires.

The secretariat also wishes to acknowledge the valuable assistance received from persons and institutions in many countries.

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ABBREVIATIONS

BIMCO	Baltic and International Maritime Conference
c.i.f.	Cost, insurance, freight
ECA	Economic Commission for Africa
f.o.b.	Free on board
grt	Gross registered tons
IAPH	International Association of Ports and Harbors
IMCO	Inter-Governmental Maritime Consultative Organization
nrt	Net registered tons
OECD	Organisation for Economic Co-operation and Development
UNCTAD	United Nations Conference on Trade and Development

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References to dollars ($) are to United States dollars.

TERMINOLOGY

Port charges – general term covering both port dues and specific port tariffs.

Port dues – charge applied either on ship or on cargo (or both) for the general use of the port, without any service being specified.

Specific port tariff – charge applied for the performance of a specific port service.

Port entity – a public or private body providing some (or all) of the port services and facilities. A port may contain several port entities.

Port authority – the port entity which, under various names, is responsible for the administration of the port.

Transit storage – the storage of goods in transit shed or open areas, for the short period normally necessary for the carrying out of the port operation (loading/unloading, clearance, receipt/delivery).

Warehousing – the storage in warehouses or other areas of goods which, for various reasons, need to remain in the port longer than the transit storage period.

Berthing/unberthing – service given to ship when it approaches or leaves a berth (e.g. the mooring lines).

INTRODUCTION

Section III of the programme of work of UNCTAD in the field of shipping recalls that:

> "Conference recommendation A.IV.22 (paragraph 2) called for greater efforts to be made towards improving port operations and connected inland transport facilities. As the cost of cargo handling in ports (including the cost of ships' time spent in ports), together with the cost of connected inland transport, represent in many cases a substantial proportion of total transport costs, the recommendations stressed the possibilities of reducing such costs by the improvement or expansion of port facilities. It further pointed out that to this end international financing, aid and technical assistance should be made available on favourable terms and conditions".*

The research and technical assistance activities of the UNCTAD secretariat have shown that a significant factor in the improvement and expansion of port facilities, and in the effectiveness with which a port's assets are utilized, is the system of pricing adopted. Many ports have realized the intimate connexion between the pricing system and improvement and expansion of the port on the one hand and efficiency of its use on the other, and have requested technical assistance in this matter. In the light of this accumulated evidence it seemed to the secretariat essential that a full report on the subject of port pricing should be prepared for the guidance of the Committee on Shipping and of future technical assistance projects. The objective of the present study is to cover these two needs; in the preparation of the study the question of technical assistance in the matter of port pricing has been borne very much in mind.

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* 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 VII, section III.

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SUMMARY AND CONCLUSIONS

I. In a previous report of the UNCTAD secretariat, the allocation of benefits resulting from port improvements was considered of such importance that a specific study of this subject was proposed.*

II. Developing countries are continually being urged to give priority to the improvement of port facilities. A number of countries have spent substantial sums of money over the past few years on port improvements and, in a number of cases, significant benefits, such as a reduction in turn-round times of ships, have been achieved. Any national authority, in considering whether to make funds available for port investment, has a legitimate concern to see that a reasonable proportion of the benefits accrue to interests within that country. One of the purposes of this study is to explore means of allocating the benefits arising from the use of the port among the parties concerned.

III. Another use of the port-pricing mechanism is to promote the better utilization of the port's assets. In the case of facilities in short supply, this can be done by applying charges which encourage port users to minimize the use they make of the assets. Where facilities are more than adequate for needs, the proper utilization of assets implies charges which constitute an incentive to port users to maximize their use of the assets.

IV. The present report discusses these objectives and indicates how, depending on the particular constraints which limit the freedom of action of port authorities, such objectives can be achieved by the port-pricing system.

V. Few ports at present have a wholly rational port-pricing system. One reason is that the concept of the autonomous port is a relatively recent one. In the past, many ports were administered by bodies such as customs or municipal authorities or directly as a government department, and port charges were therefore established and amended to satisfy not only the port requirements, but also those of the other parties involved. As a result, most port-pricing systems are very complicated; in consequence of technical progress in the operation and use of ports, such old-fashioned pricing systems have become unsatisfactory. As an illustration, it may be indicated that many of the countries seeking technical assistance for the purpose of improving their ports include pricing as a subject on which they need guidance.

VI. The need to base the calculation of port charges on sound principles has been expounded for many years. The first important step was taken in the 1940s, when the "Freas Formula" proposed that charges should be related more closely to costs in the ports of the United States of America. During the late 1950s and 1960s, possibly under pressure from financing institutions and also because of the improvement and mechanization of port accountancy, several projects seeking to relate port charges more closely to port costs were carried out.

VII. This report takes the investigation somewhat further, in that it questions the necessity for charges to be directly related to the flows of disbursed costs as usually recorded by accountants. The costs to which attention needs to be directed are the economic costs, that is, the costs to the economy as a whole in terms of the ressources which are used to provide services and which, if not used in the ports, could be used elsewhere in the economy. Some important assets, such as port infrastructure, which once constructed have no alternative use, have no economic costs, and their apparent costs may not therefore be relevant in pricing. However, since interest payments on the finance used to acquire or construct the assets, constitute an outward cash flow from the port, there needs to be a sufficient inward cash flow to make these payments. Furthermore, when allocating general costs, arbitrariness cannot be avoided, and hence attempts to relate unit charges directly to unit costs (once allocated) do not in practice succeed in relating charges to costs without arbitrary decisions.

VIII. The present report by the UNCTAD secretariat argues that although it is essential to know what are the costs in port and to relate certain charges to costs, these are not the only elements to be taken into account for pricing purposes. Port investments are very costly, and technical progress gives them a shorter useful life than was the case in the past. It is particularly important to use them economically, and port charges have a function to perform in this respect. Similarly, the benefits derived by the user from the port installations, or in other words "what the traffic can bear", place an upper limit on the price to be charged, in that the benefits derived by users from the services of the port represent the maximum amount of revenue which the port could ever tap; in practice, the actual maximum will be lower. These three elements – costs, utilization of installations and what the traffic can bear – must all be taken into account in building up a realistic and adequate pricing system.

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* "The question of the allocation of benefits from port improvements is one which cannot be taken up fully in this report. It is, however, a subject of such importance that it is proposed that a future secretariat paper be devoted to this subject." (*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), part one, para. 14.)

IX. It is believed that the approach proposed for calculating port charges will prove satisfactory, particularly in developing countries. It is for the sake of these countries, and of the least favoured of their ports, that certain topics have been given particular attention in this report. Through the experience gained from technical assistance, the UNCTAD secretariat is aware of the difficult conditions under which some ports have to work, and the selection of material for inclusion in the report is based on this experience.

X. The report does not claim to be exhaustive. However, most of the topics relevant to a revision of pricing have been examined. The examination of some, such as the simulation of the new pricing system, methods of traffic forecasting and the application of the methodology proposed in concrete cases, could be extended. It is the secretariat's intention to continue working on this subject through the implementation of technical assistance projects.

XI. The following is a summary check list of tasks to be carried out in establishing a new port tariff:

1. The definition of a pricing period over which port prices will be calculated;
2. The definition of the facilities and services to be charged for;
3. The identification of the users of each of these facilities and services;
4. The identification of the nature and extent of any constraints which affect the pricing process;
5. The definition of the objectives of the pricing system and the way in which they affect the capacity to raise revenue from any group of users;
6. The selection of a reference year for which a first estimate of port charges will be calculated;
7. The establishment of cost and revenue centres defined so that they can be clearly related to each other;
8. The definition of a pricing structure (type of charge, basic unit);
9. The calculation of annual costs;
10. The calculation of the minimum annual flow of revenue required to be raised in the light of the constraints and objectives, including the possible need to provide funds to cover the costs of new investments;
11. By an iterative process, the determination of the set of charges that satisfies all the necessary conditions, first for the reference year and then for the pricing period as a whole for any year;
12. Before putting the new set of port charges into effect, the operation of a dummy run alongside existing charges, for the future pricing period.

Part one

APPROACH TO THE STUDY OF PORT PRICING

In part one, the various factors which affect the determination of port prices are examined. Among these factors, the most important are: pricing objectives and constraints; supply of and demand for port facilities and services; flow of benefits, costs and revenue. The factors are analysed separately, and quantitative data showing their respective importance are provided. In addition, the various pricing systems at present applied in the world are reviewed.

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Chapter I

THE FUNCTION OF PRICING IN PORTS

A. Introduction

1. A port represents a collection of physical facilities and services designed to serve as an interchange point between land and sea transport. The provision of the services and the provision and maintenance of the facilities create a flow of costs for the port entity. The use of the facilities and services by the users of the ports creates for them a flow of benefits and it is to obtain these benefits that they make use of the port. The port authority, or any other port entity, through its pricing policy, can tap some or all of the flow of benefits and so create a flow of revenue for the authority.

2. There are, then, three separate elements which are important in the port-pricing field, namely the flow of costs, the flow of benefits and the flow of revenue. The costs are borne by the port authority or other parties providing facilities and services within the port, whereas the benefits accrue to the users of the port, namely cargo-owners and ship operators. The revenue which can be created by tapping the flow of benefits accrues to the port entity concerned and represents the income from which it can finance its operations.

3. A stricter definition of these three flows is needed. First, the flow of costs is considered. There are two meanings of cost and each is relevant. The first is the real or economic cost, which is the cost of the resources used, such as capital, land and labour, which have alternative uses. In the absence of marked unemployment, labour can always be used in alternative ways and thus always has an economic cost. Land may, or may not, be capable of an alternative use, although in most ports situated in densely populated areas of great economic activity the value of the alternative use of land may be greater than that of its actual use in the port. Capital, on the other hand, frequently has no alternative use. Once a quay is built, it is useless for anything other than transferring goods between ships and inland; a breakwater can provide a sheltered haven and nothing else. Where there is no alternative use, there is no economic cost. Realistically, however, a port is concerned with its own costs in the sense of the annual cash outflow. Thus, while in principle, a pricing system has only to deal with economic costs, in practice, it has to provide a cash flow to meet the payments which the port must make, whether for costs which are recognized as economic or for those which are not.

4. The benefit derived by port users also needs clarification. There are two main users: the cargo owner and the shipowner. The benefits become clear if the value of a product is considered at its point of production in relation to its value in the market. In many cases – and as far as raw materials are concerned, in most or even all cases – the intrinsic value of a product at the point of production is zero. It is the existence of a market, probably far removed, which gives it a positive value. The difference between the two values is the benefit which accrues from the ability to transfer the product from the point of production to the point of sale. Many interests are involved in this. So far as the port is concerned, the only relevant interests are those of the cargo owner and those of the ship operator. The cargo owner sends his cargo to the port because, by doing so, by putting it at the point where the land transport and distribution system of his own country connects with the means of ocean transport, his product acquires a higher value than it would otherwise have. The ship operator sends his ships to the port because the product can have a higher value at the land/sea connecting point in the market area than it has in the production area. The benefit of each party is thus strictly measurable. For the cargo owner, it is the difference between the value at the point of shipment (the f.o.b. value) and the value at the point of production, minus the costs of transporting the product from one point to the other. For the shipowner, the benefit is that part of the difference in value between the point of loading and the point of unloading which he can appropriate to himself through freight rates, minus the costs involved in effecting the physical transfer. Any port authority needs to be fully aware of at least the approximate value of these two flows of benefits since they determine the limits of its capacity to raise revenue.

5. The revenue to the port authority is that part of the benefit created for cargo owners and shipowners which the port authority can tap. It cannot tap more than the benefits it creates. If it tries to charge cargo owners more than the benefits offered to them by the port, the flow of cargo will dry up (either by ceasing to be traded or by going to another port). If it tries to charge shipowners too much, the ships will not call. It is for the port to decide how much of the benefit if confers on ships and cargo is to be left with the ship and cargo interests and how much is to be converted into a flow of revenue to defray its own costs.

6. If a port is operating economically, then the flow of benefits will exceed the flow of costs. The relationship between these two flows and the judgement of the extent to which the port is economical are independent of the actual flow of revenue to the port. The flow of revenue to the port entity is a consequence of the pricing system

which is used and of the level of the various charges which are made.

7. It is necessary to make it clear that charging for facilities and services does not reduce the real or physical benefits which the users enjoy. These are left unchanged. What the pricing system does is to transfer the advantages gained by the recipients of the benefits, wholly or in part, to the provider of the benefits in the form of a flow of revenue. Clearly, the net or residual benefit which the user enjoys after paying the port charges levied on him is lower than the original benefit which he enjoyed. Equally clearly, the port user must enjoy a net benefit from using the port or else he will cease to do so.

8. The efficiency of pricing systems designed to redistribute benefits depends on the proper identification of such benefits and on their quantification in financial terms. Once expressed as a financial flow, the benefit can be re-allocated through the pricing system. Situations arise, however, where certain indirect benefits cannot be readily quantified and expressed as a financial flow. Where this occurs, the pricing system will not be able to tap all possibilities of re-allocating benefits from the users to the providers of services. For a port, this may be particularly important, since some of the benefits are likely to be indirect. Nevertheless, it still remains true – even in that particular case – that any port-pricing system involves a financial re-allocation, between the port users and the providers of port services and facilities, of the benefits arising from the utilization of the port.

9. Given that the function of port pricing is to re-allocate benefits, it is necessary to specify the desired level of this allocation. This is a policy decision, which is likely to be peculiar to each individual port. Nevertheless, the upper and lower limits of the possibilities of re-allocation are, in principle, the same for all ports. At one extreme is the situation where the port is regarded as providing a service for which no charge is made. In such a situation, each user of the port would then retain in full the flow of benefits which the use of the port yields to him, and the port entity would derive no revenue from the facilities and services which it provides. This "no charge" situation is, in practice, very rare, but it does exist in some ports, for some, if not for all, facilities and services. At the other extreme, is the situation where all the benefits created by the port entity are tapped by the pricing system and converted into a revenue flow. This is equally rare, since no port entity can ever obtain more revenue than the equivalent of the flow of benefits created by the operation of the port and, in practice, a port would find it difficult to tap the full flow. Accordingly, the basic problem with which each port is faced is to determine the desired level of the re-allocation of benefits, i.e., the point between these two extremes which is most consistent with the port's policy. For this purpose, two kinds of parameters may be introduced: they will be called constraints and objectives.

10. Constraints are authoritative parameters which have to be observed in any case. Objectives are indicative parameters, giving a direction or an aim which may not be fully reached but which needs to be aspired to. Both contribute to the accurate definition of the port-pricing function.[1]

B. Port-pricing constraints

11. The first port-pricing constraint is the need to cover, through port charges, the costs which are incurred by the port entity. In effect, since the flow of costs represents financial obligations, the port entity will need to obtain a flow of income to enable it to discharge these obligations. In normal circumstances, this income will be the flow of revenue obtained from port charges. In the case of the self-supporting port, the flow of revenue must be at least equal to the flow of costs. If there is an excess, it will take the form of a profit which may, or may not, be used to create a reserve to finance future investment or to meet possible future deficits.

12. The cost constraint may be conceived for each service separately or for the port as a whole. In the former case, where each service is self-supporting, the limits within which the re-allocation of benefit may be carried out are very narrow. Such a limitation may hinder the achievement of additional aims, for example, the proper utilization of assets. Thus, while it needs to be known, and hence be a conscious decision concerning which services are, and which are not, self-supporting, a broad cost constraint, namely, that the port should cover its costs, gives greater operational flexibility and is more conducive to economic and efficient over-all operation.

13. It has to be clearly specified that in some cases the cost constraint cannot be satisfied, particularly when considered for each service rather than for the port as a whole. This happens when the level of benefits resulting from a service provided by the port is below the cost of providing it. Such a situation may result from *(a)* mistakes in investment planning, *(b)* the initial low utilization of a new investment or *(c)* the fact that certain port assets are indivisible.[2] In cases *(a)* and *(c)* there may be a permanent gap between revenue and costs, whereas in the case *(b)* the gap is normally a temporary one. In such cases, cross-subsidization of one service by another may be, if possible, used for bridging the gap. Nevertheless, there is a limit to such cross-subsidization, because no user will pay for the use of an asset more than the benefit which he derives from its use, and it may be difficult to compensate for an excess of costs over revenue in one area by higher charges in another.

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[1] Some practical guidelines for determining pricing constraints and objectives will be given in part two, chap. I.

[2] This happens when the minimum size of an asset is greater than that actually required. For example, if two tugs are required to berth a ship, two must be maintained even if used only once each week, since without them the port could not function.

14. There are sometimes additional constraints, some of which result from the administrative status of the port. For instance, the port entity may receive instructions from the public authorities to give particular treatment to certain national port-users (owners of either ships or cargo). This treatment may limit the port charges which can be applied and hence the level of the benefit that can be re-allocated. To what extent such outside intervention is or is not desirable will be examined later (see below chap. II, paras. 47 and 48).

15. An additional constraint which applies in all ports is the need to ensure a good matching of inflows and outflows of cash (liquidity), in others to ensure that cash for making payments will become available at the right time in the form of corresponding liquid financial resources. Any disequilibrium in these two financial flows[3] will necessitate measures – for example, because the port has to borrow and hence to incur interest charges – which could have an effect on the allocation of benefits through port prices.

16. The other parameters of the pricing function – the objectives – are less authoritative than constraints. As a result, if there is a conflict between the constraints and the objectives, it is the realization of the objectives that will suffer. Like constraints, the pricing objectives nevertheless contribute to the defining of the level of the re-allocation of benefits.

C. Objectives of port pricing

17. Every port should endeavour to ensure that its facilities are used in the most efficient manner. It is the main objective of pricing to contribute to this effort. In effect, the port users' demand for services and facilities will usually be affected by the level of the net benefit which stays in their hands after port charges have been applied. Each port has the capacity to determine this net benefit at a level which will encourage the economic utilization of the port assets.

18. If a port asset is in short supply, it may be desirable to discourage some port users from using it. In such a case, the desired result will be achieved by a pricing system that sets prices for the corresponding service so high that only those users who utilize the asset efficiently will have a net benefit great enough to make such a use worthwhile. An illustration of how prices can contribute to improving the utilization of port assets is the case of the transit-shed service. Unless the port has excess shed capacity, a pricing policy which encourages port users to allow their goods to remain in the transit shed instead of being warehoused outside the port, leads to overcrowding of the sheds and ultimately to inadequate utilization of quays and other equipment, delays to ships, waste of gang time and so on.[4] Higher charges which encourage shippers to remove their cargo from the transit sheds as quickly as possible will permit better utilization of other port assets, even if they yield lower revenue to the port. If, however, the port had excess transit-shed capacity,[5] then warehousing could be a source of income to the port and relatively low charges to encourage goods to be left in the port could secure better utilization of the transit sheds without jeopardizing the utilization of any other port assets.[6]

19. No general principle can be laid down about the optimum or most rational utilization of any particular part of the port since the best form of utilization will vary from port to port, depending on the equipment and capacity of the port in relation to the volume of cargo and the number and type of ships using the port. What can be said, in a general way, is that for any service which is limited in relation to the demand for it, the objective of securing a rational utilization of the assets demands that the service be charged for in such a manner that it will be used mainly for the most valuable purposes.

20. The objective of ensuring the most economical utilization of assets cannot always be achieved through port charges alone. The pricing system can only influence the utilization of assets in as far as the demand for the services of those assets is elastic. When demand for a service is inelastic in relation to the price, other measures, generally more authoritative than pricing, have to be found.

21. There are many other possible objectives which may be assigned to port pricing but which cannot be studied here. However, one additional objective of port pricing of particular interest for ports in developing countries, namely, to establish charges at a level which tends to retain in the country the benefits arising from port improvements, must be discussed. In all ports, some users are foreign, and it may happen that such users have the possibility of not passing on to the country in which the port is situated the benefits which they derive from port improvements. An illustration is the case of a foreign shipowner who is in a monopolistic position. In such cases, port pricing, by tapping all or part of the user's benefit, may contribute to ensuring that benefits will not escape the country. It will be seen later (para. 23 below), that in some cases there are other elements which may hinder the full achievement of such a particular objective.

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[3] Outflows of liquidity should not be confused with outflows of costs. The former are concrete liquidity needs (e.g. reimbursement of a loan), the latter are the expression in financial terms of the real cost of operating the port (e.g. depreciation).

[4] For an illustration of the way in which overcrowded transit sheds limit berth throughput, see *Berth throughput – Systematic methods for improving general cargo operations: report by the Secretariat of UNCTAD* (United Nations publication, Sales No.: E.74.II.D.1).

[5] Excess capacity needs careful definition, because what seems to be an excess supply of port assets is often nothing more than a normal provision for traffic variation. The real excess supply starts beyond such a provision for traffic variation. This question is discussed in the report cited in foot-note 4.

[6] In order to discourage bad practices, it would be desirable to apply such a policy only to those storage areas away from the quay apron, which should always be kept clear.

22. Another pricing objective which deserves particular attention is that of building up financial reserves for cushioning the port against unexpected falls in revenue or rises in costs. Admittedly, the constitution of reserves implies fixing port charges at a level at which the planned annual flow of revenue is greater than the expected annual flow of costs. Nevertheless, a situation may arise in which the acceptable amount of the reserve is rather limited, mainly because higher reserves would hinder the achievement of other more important objectives. For instance, the improvement of the utilization of assets may require low pricing rates, and hence permit the accumulation of only limited reserves.

23. Figure 1 gives a schematic representation of the steps by which the pricing level may be determined. It shows how the two initial upper and lower pricing limits define a pricing zone, which is reduced when pricing constraints and objectives are successively introduced. In column A, the annual benefits arising from the use of port facilities and the provision of services is represented. Column B shows the corresponding annual costs. The two extremes of the pricing function are indicated in column C, namely, the case where all benefits are tapped and no charges are levied. Pricing constraints and pricing objectives are then successively introduced in the appropriate order of priority. First, the cost constraint tends (column D) to compress the pricing zone by raising the lower limit to equal the cost increase. In column E, the effect of an outside constraint (e.g. governmental) which limits the upper pricing limit to the level EE_1 is illustrated. Then, in column F, the effect on the ceiling price of a need to encourage the improvement of the corresponding asset utilization by further limiting revenue is indicated by reducing the ceiling to FF_1.[7] In column G, the lower pricing limit is raised to GG_1 because of the need to build up financial reserves. The pricing zone is thereby reduced to the area FF_1GG_1. In column H, the possible effects of a requirement to construct prices in such a way that benefits will stay in the country are introduced. In fact, it is shown that this particular objective cannot be achieved because it implies raising more revenue than is possible in view of the prior more authoritative constraint which calls for an improved utilization of assets, namely FF_1 in column F. Hence, the result is that FF_1 gives the pricing level which is most in conformity with the existing pricing constraints and objectives.

24. The discussion here of objectives and of benefits, cost and revenue flows is obviously incomplete. However, it was considered better to limit the initial discussion of these somewhat theoretical issues and to proceed to consider more practical questions, returning at the end of this part of the report to the analytical question, rather than to attempt a "full-dress" presentation here. This view is in keeping with the essential function and object of this report, namely, to influence the pricing practices of ports. Thus, the general discussion has been designed to begin with a brief résumé of the underlying theoretical questions; these will be dealt with fully after the relationship between theory and practice has been discussed.

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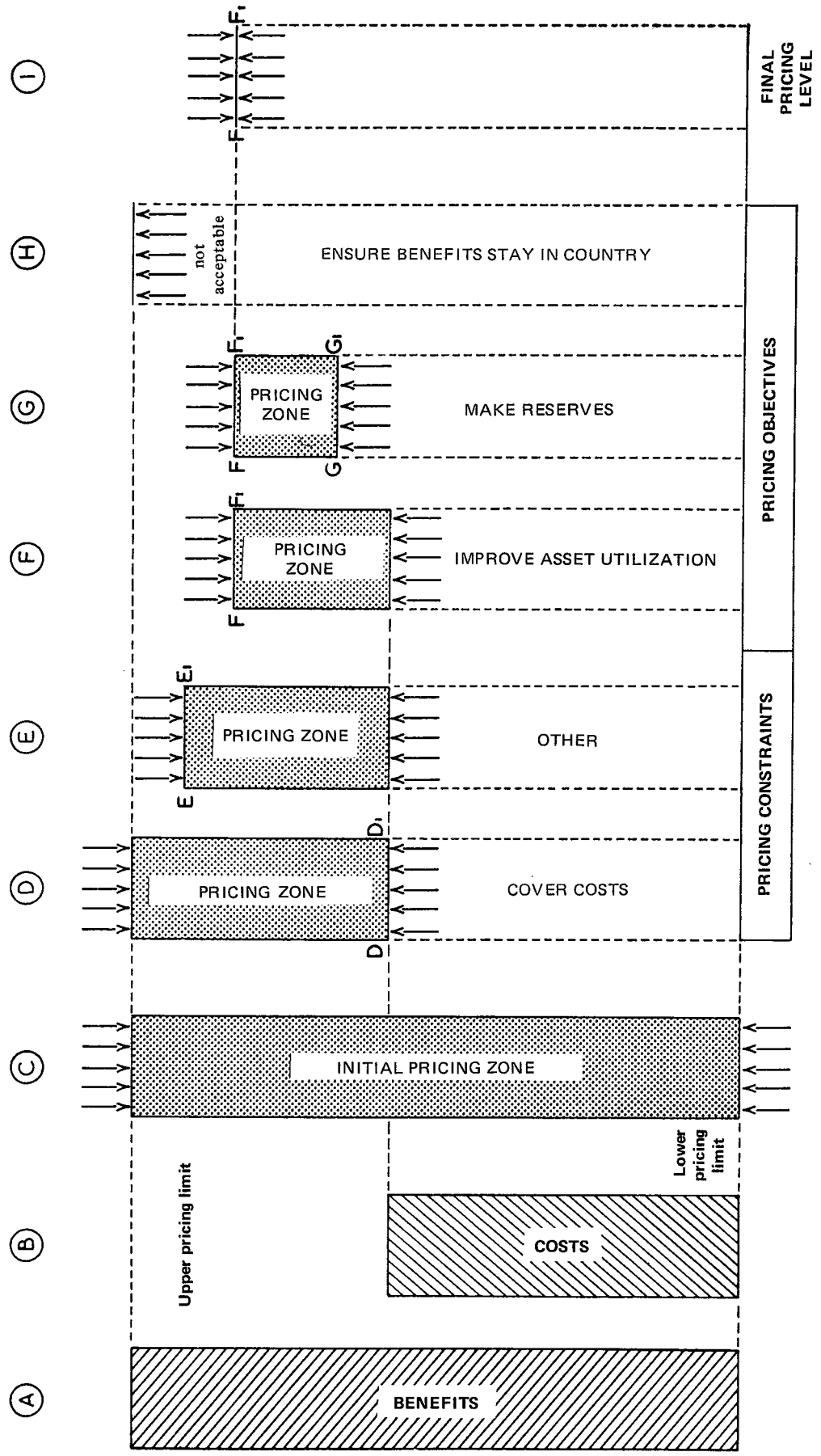
[7] As mentioned earlier (para. 18 above) the improvement of the efficiency of the utilization of the asset may involve higher charges for the service in question.

FIGURE 1

Steps in the determination of the pricing level



Chapter II

PRICING AND THE ADMINISTRATIVE STRUCTURE OF PORTS

25. The pricing policy of any port is conditioned by various elements of which an important one is the administrative status of the port entity managing the port. In order to help each port better to define its pricing policy and set its charges, a statistical analysis of the administrative structures of ports has been carried out.

A. What is provided to users in ports?

26. In the interests of simplification, special port-users such as passenger ships or fishing boats will not be dealt with even though, in some ports, they account for a large share of the traffic. It will be considered that the main port-users are cargo owners and cargo transporters.

27. Writers on the subject of ports[8] frequently distinguish between *(a)* port facilities, which comprise the various physical assets that together constitute the port, such as breakwaters, quays, etc. and *(b)* port services, which lend life to these facilities, for example, pilotage, cargo handling, etc. The object of these facilities and ancillary services is to ensure that goods are transferred in the most efficient manner between ships and a means of inland transport (road, rail, or inland waterway).

28. Figure 2 shows the main port facilities and services provided for ships and cargo. The inward movement of ships and of import cargo in the port are represented on the left-hand side, by two vertical streams, which diverge when, at the point where land and sea meet, the cargo goes inland. On the right-hand side of the diagram the export cargo movement is shown, and this movement links with the ship when loading is finished and ship and cargo remain together for the outward voyage. Some complementary services to ship and to cargo are illustrated on each side of the chart.

29. It is to be noted that some of the port facilities and services are peculiar to a certain category of ports (e.g. small ports give fewer services than big ones). Others are dictated by the port's topography (e.g. locks, lighterage), while yet others conform to local practices (e.g. in some ports there is no storage for exports).

30. Nevertheless, port services and facilities are broadly comparable from port to port, although they may be provided in different ways by various port entities.

B. By whom are port services provided?

31. In order to answer this question properly, an attempt has been made to find what happens in this field throughout the world. For this purpose, a questionnaire was sent to 114 ports in 106 countries.[9] By April 1972, 81 replies had been received from 68 countries distributed as follows:

Central America and South America	13
North America and the Caribbean	4
Western Europe	17
Eastern Europe	1
Middle East	10
Asia and Australasia	15
Africa	21
Total	81

32. Although the sample thus obtained cannot claim to be representative of all ports in the world, it is, nevertheless, sufficiently broad and diversified to show certain trends.

33. On the basis of this statistical sample, a study has been carried out of the distribution of main port services to ships and cargo among the principal port bodies. The bodies have been classified according to the following three standard structures:

(a) Port authority (generally public);

(b) Other public bodies (State or municipally-operated enterprises);

(c) Private undertakings.

The results obtained are shown in table 1.

34. As will be seen from table 1, the distribution of functions in the supply of port services in developed countries differs widely from that in developing countries. The following summary of table 1 helps to show this diversity more clearly.

[8] See, for example, J. Grosdidier de Matons, *Le régime administratif et financier des ports maritimes,* Paris, Librairie générale de droit et de jurisprudence, 1969, p. 322; J. G. Baudelaire, *Administration et exploitation portuaires,* Paris, Eyrolles, 1969, p. 21; E. E. Pollock, "Port charges and depreciation policy as a means of promoting efficient shipping operations", paper submitted to the International symposium on development of ports and increased world trade, Bergen, October 1970.

[9] The questionnaire is reproduced in annex I below.

FIGURE 2

The movement of cargo and ship through a port: main facilities and services provided by a port

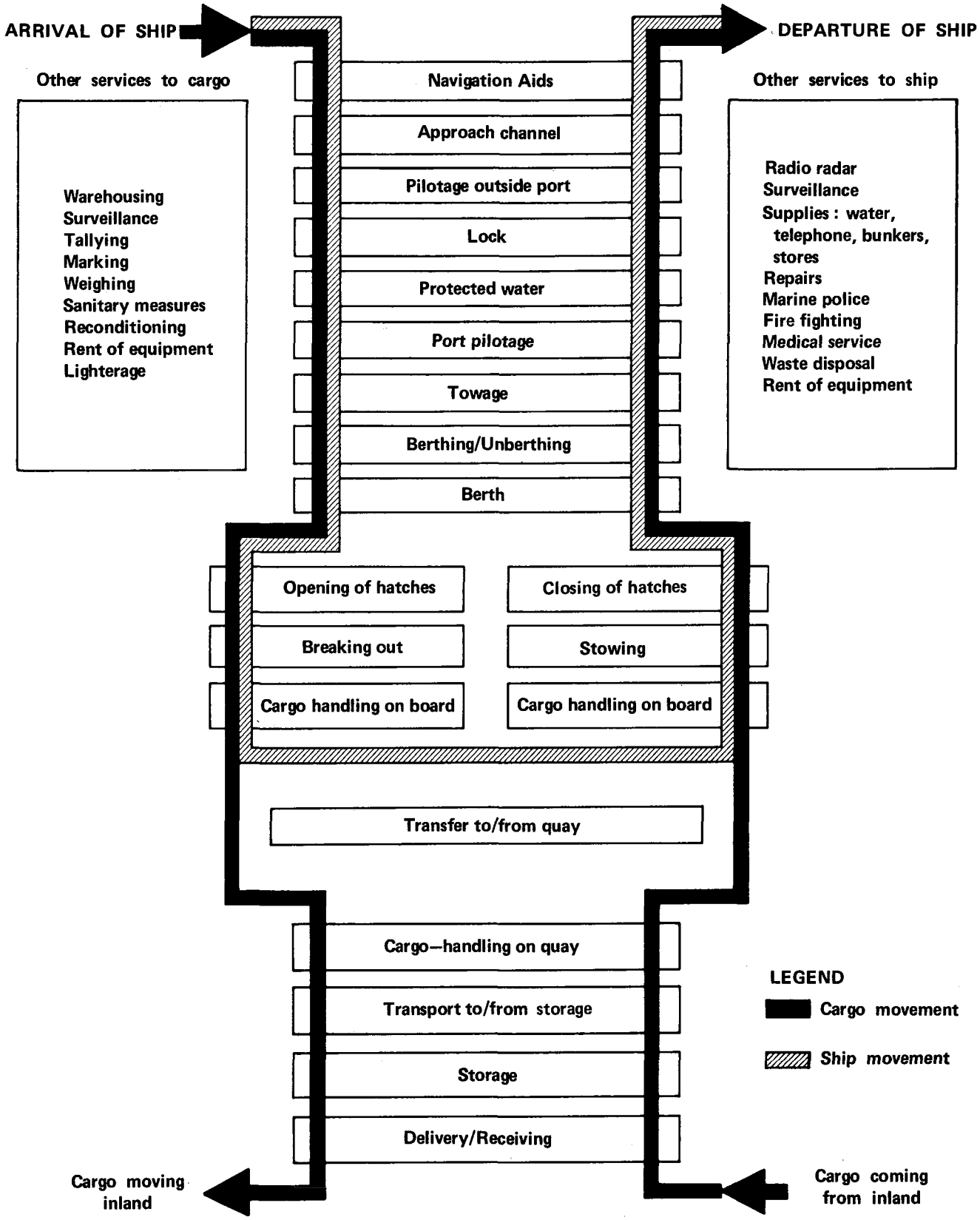


TABLE 1

Providers of the main services in ports

Main port services	*Developed countries*				*Developing countries*			
	Port authority	*Other public bodies*	*Private undertaking*	*Total*	*Port authority*	*Other public bodies*	*Private undertaking*	*Total*
Services to ships								
Aid to navigation	10	13	0	23	36	17	0	53
Pilotage	10	8	5	23	36	7	12	55
Towage	6	1	13	20	35	4	16	55
Berthing/unberthing	4	0	17	21	31	3	18	52
Repairs	0	1	21	22	9	7	35	51
Marine police	7	13	0	20	13	33	0	46
Fire fighting	6	16	0	22	32	23	0	55
Services to cargo								
Stevedoring	3	1	18	22	10	11	36	57
Cargo-handling on quay	4	2	18	24	27	10	19	56
Surveillance	6	5	12	23	20	13	21	54
Tallying	5	2	16	23	22	11	22	55
Weighing	7	5	11	23	28	9	16	53
Storage	8	3	12	23	34	10	12	56

Source: Compiled by the UNCTAD secretariat.

NOTE. Not all ports provide all services, and some ambiguous answers have not been retained. This explains why the numbers in the "Total" columns vary slightly.

35. *Ports in developing countries*

(a) In most cases, the port authority is responsible for the following services:[10]

Aids to navigation
Pilotage
Towage
Berthing/unberthing
Fire fighting
Cargo-handling on quay
Storage
Weighing
Tallying of goods;[11]

(b) Other public bodies are generally responsible for the following service:

Marine police;

(c) Private undertakings are often responsible for the following services:

Stevedoring
Tallying of goods[12]
Repair of ships
Surveillance of cargo.

[10] Only the main services are mentioned here. The port authority is also often responsible for the construction and maintenance of facilities.

[11] In this sample, such a service is distributed evenly between the port authority and private undertakings.

[12] *Idem.*

36. *Ports in developed countries*

(a) The port authority is responsible in most cases for the following services:[13]

Pilotage;

(b) Other public bodies are generally responsible for the following services:

Aids to navigation
Marine police
Fire fighting;

(c) Private undertakings are generally responsible for the following services:

Towage
Berthing/unberthing
Stevedoring
Cargo-handling on quay
Storage
Repair of ships
Surveillance of cargo
Tallying of goods
Weighing.

37. *Comments.* Broadly speaking, the ports of developing countries may be said to be characterized by the existence of a port authority with far-reaching powers and by a public monopoly of the main services. In developed

[13] See footnote 10 above.

countries, the responsibilities of the port authority are generally less extensive, being limited to the construction and maintenance of facilities and sometimes the official or unofficial supervision of other services. Other port activities of a public service nature (police, fire fighting, etc.) are often the responsibility of State enterprises, while commercial activities are mainly the province of the private sector and often give rise to competition.

38. As regards the pricing policies of these various ports, it is clear that they are often framed in different contexts. Consequently, the pricing objectives and constraints of the ports, and hence the charges themselves, may be entirely different. Even within a particular port, where different bodies may be pricing their services separately, it can happen that their pricing policies diverge and even conflict: e.g. the optimum use of a quay for a representative of a private shipping company may not be the same as that for the public port authority.

39. At first sight it may not seem possible to say what is, from the pricing point of view, the most desirable distribution of port services among port entities. However, in the light of the requirements of a sound utilization of assets, some guidelines can be provided. This pricing objective of such utilization is necessary in order to encourage the most efficient use of the port; and this efficiency is, in turn, necessary to enable the port to give the best service at the minimum cost.

40. As a general rule, it is desirable that the port services which are closely complementary should be within the competence – or at least under the control – of the same body, whatever its administrative status. Examples of these closely complementary port services are cargo-handling on board and cargo-handling on quay, or cargo-handling on quay and storage and delivery. If such services are performed by different bodies working independently, it will be difficult to achieve the best utilization of the port's assets. Similarly, there should be co-ordination[14] of all the different organizations which operate in the port. It is desirable, for example, that the port authority, stevedoring companies, customs officials, etc. should have the same hours of work. Lack of such co-ordination invariably impairs the utilization of the port's assets. Furthermore, and even where some competition between ports in the same country is allowed, an over-all national co-ordination of port services is advisable. This co-ordination should normally apply also to other fields which, in fact, are closely linked with pricing: port investment, labour policy, etc. It is particularly important that developing countries should have such a national, and even in some cases a regional, port policy, in order to avoid unnecessary duplication of very costly investments and to keep transportation costs to a minimum.

41. The second guideline which can be suggested in this respect is that the optimum utilization of assets should be understood from a national point of view. This, of course, applies mainly to public assets, although private assets built in public ports should be subject to regulation, in order to take account of the national interest. When a public body is responsible for providing the public port facilities and services is should normally safeguard the national interest. But it may nevertheless happen that such a port entity has to take into account both local and national interests. When the two interests conflict, the national one should normally prevail.

42. Co-ordination and the priority of the national interest may be ensured in different ways. The two extremes are, on the one hand, administration by a single governmental body of the port as a whole, or on the other hand, operation by a private firm which has leased complementary port assets (e.g. quays, apron, transit sheds) and hence ensures good co-ordination of the services provided. In this latter case, the safeguarding of the national interest will normally be implicit in the leasing contract. Between these two extremes, other combinations are possible. The greater the number of separate firms, however, and the more the administrative status of a port differs from that of a public one, the greater should be the power given to the co-ordinating body and the greater should be the care taken by this body to ensure the defence of the national interest.

C. The statutes of port authorities

43. The analysis of the administrative statutes of port entities will be limited to the port authority, although the results may be relevant to other public port bodies, such as a public corporation performing cargo-handling services.

(1) *The administrative statutes of port authorities*

44. Publicly-owned ports belong to either the State, a regional body or a local body (e.g. a city).[15] The responsibility for administering such ports is vested in an organization which in this study is called the "port authority". It has been seen above that the scope of the activities of the port authority varies widely from one country to another. Also, its administrative statutes vary between the two extremes, namely, those of a private firm

[14] On the co-ordination of port services see also: Th. Thorburn, "The function of maritime ports", *The future of the European ports*, R. Regul, ed. (Bruges, De Tempel, 1971), vol. I, p. 17.

[15] A recent study covering 70 ports which answered a questionnaire sent to 100 ports in the five continents, has given the corresponding indication regarding types of port undertaking:

Public trusts and public corporations	40 per cent
Municipally owned	28 per cent
Government department	26 per cent
Miscellaneous	6 per cent
	100 per cent

For more details, see Stanley Johnson, "Financial Policies for Ports", *Proceedings of the Seventh Conference of the International Association of Ports and Harbors*, Montreal, 6-12 June 1971 (Tokyo, IAPH), p. 281, para. 7 *et seq.*

engaged by contract, and those of a government department.[16] The first case, which, according to certain authors, was common a century ago,[17] is much less common now. (Of 81 ports which answered the first UNCTAD questionnaire, only one falls into this category. Nevertheless, some specific areas, like Central America, still have some ports administered by private firms.)

45. The second case, where the port is administered by a government department is still common, although there is a trend towards a third type where the administrative statutes are intermediate between these two extremes, namely, those of an *autonomous port authority*. The statutes of such autonomous port authorities may be quite different. Nevertheless, their common feature is the function of facilitating a commercial exploitation of the port and limiting governmental intervention to some fields having important national implications (such as pricing, investment planning, etc.).[18]

46. Of 81 port authorities which answered the first UNCTAD questionnaire (see annex I), 15 out of the 25 ports in developed countries and 25 out of the 56 ports in developing countries, claimed to be autonomous. However, other studies have shown that a much smaller proportion of ports has reasonable freedom to fix their own charges.[19]

47. An autonomous port authority seldom has complete freedom to establish or change port charges. In most cases governmental approval has to be obtained before any important change is made. In this way, the government can check that the pricing policy of the port is satisfactory from the national point of view. In general, the main governmental intervention can take the following form:

(a) Asking all port authorities of the country to adopt the same pricing structure (port authorities being free to fix basic rates);

(b) Controlling the over-all level of income from port charges on ship and on cargo, in order to ensure that these levels stay within limits which are acceptable from the national point of view (e.g. governments may allow a new system of port charges providing that a global income is not increased or is increased by only a certain percentage, etc. . . .);

(c) Controlling the basic level of some port charges concerning privileged port users (e.g. some import or export products of great interest for the country).

48. Provided that the control imposed is not too tight, the autonomous port authority may operate the port on a commercial basis, since the main port users, cargo-owners and shipowners, also operate on such a basis. Furthermore, the port authority which knows the local users and their requirements, is in a better position to take such requirements into account. Nevertheless, the independence of such an authority may be hampered by too great a degree of governmental intervention in the pricing and other administrative, financial and technical fields.[20] In such a case, the autonomy is not real and, as a result, it is quite difficult both to satisfy the governmental requirements and to ensure the efficiency of day-to-day operations.

49. Autonomy may not be possible in all ports. Small ports cannot bear the burden of such a heavy administrative structure. This is why some countries, both developed and developing, have successfully grouped several ports (small and large) under one autonomous board. Here the adoption of common policies, not only in pricing but in other fields like the allocation of traffic, of investment, etc., permits the more efficient operation of the whole group of ports. But once this national policy is adopted, it again becomes desirable to give enough freedom to each port to implement this general policy, taking into account local requirements.

(2) *The financial statutes of port authorities*

50. It is quite clear that the pricing policy of any port is conditioned by its financial statutes. In order to gain an insight into current practices in this field, a second quantitative analysis was carried out. The analysis was confined to two statistical studies, one relating to the conditions for financing the various port facilities and the other to the financial objectives adopted by port authorities.

51. For this purpose, a second questionnaire[21] was sent to 62 ports in 60 countries. Altogether 43 replies from 41 countries were received, with the following geographical distribution:

Central America and South America	5
North America and the Caribbean	2
Western Europe	12
Eastern Europe	1
Middle East	5
Asia and Australasia	10
Africa	8
Total	43

[16] With regard to the respective advantages of each system, see also Howard Mann, "The relative merits of private, state and civic ownership of ports", *Conference Speakers and their Papers: Fourth Conference of the International Association of Ports and Harbors,* London, 10-14 May 1965 (IAPH, Tokyo), vol. 2, p. 23.

[17] See, for example, Walter P. Hedden, *Mission Port Development . . . with Case Studies* (Washington, D.C., The American Association of Port Authorities, 1968), p. 75.

[18] "Usually, the following decisions of the Port Authority are subjected to government's approval: yearly budgets, loans and obligations above a certain limit, all foreign loans, contracts for large works exceeding a high predetermined amount, general level of main port dues, appointment of Board's chairman and the Managing Director, sale or longtime lease of property and matters affecting national security and the foreign policy." (Bohdan Nagorski, *Port Problems in Developing Countries* (Tokyo, IAPH, 1972), p. 156.)

[19] Of the 70 ports which answered the British Transport Docks Board questionnaire mentioned in footnote 15 above, only 16 indicated substantial freedom as regards their charging arrangements. See Stanley Johnson, *loc. cit.*, p. 140.

[20] On the various aspects of governmental intervention in connexion with ports, see *The future of European ports, op. cit.*, vol. II, pp. 737 and 738.

[21] For the text of the questionnaire, see annex II below.

52. The first step was to determine, for the sample considered, how the main port facilities were financed. The number of replies to the relevant questions was not sufficient for a detailed analysis. However, the following points seem to emerge:

(a) In many cases, entities like municipalities or the central government participate in the financing of maritime works, such as aids to navigation and breakwaters. (Aids to navigation seem to benefit most frequently from outside help.) Such participation often amounts to more than 50 per cent of the investment cost.

(b) Participation by the government or other entities in the financing of port superstructure (for example, transit sheds), is rare and, where it happens, accounts for only a small proportion of the investment cost.

53. More than two-thirds of the ports claimed to finance all their main investments from their own resources. However, without knowing the cost at which they acquired their assets (including the cost of their loans) and their depreciation policies, it would be wrong to conclude that all these ports were self-supporting and in a sound financial situation.

54. The other statistical study concerned the financial objectives of the port authorities consulted. In 10 per cent of the cases examined, the financial objective was to cover current operating and maintenance expenses, depreciation and interest charges on loans. In the remainder, i.e. 90 per cent of the cases, there were additional objectives; either to make provision for port improvements, or to earn a return on the capital employed, or both.

55. A recent inquiry seems to indicate that most port authorities enjoy the benefit of special tax provisions which exempt them wholly or in part from the duties or taxes to which other enterprises are normally liable.[22]

56. Whether or not ports should be self-supporting is a matter for each country to decide. There are some ports which seem to be overtly and heavily subsidized, including several in Western Europe.[23] It is clear that the levels of port charges can be lower if there is a subsidy than if there is not. To make comparisons from one port to another with allowance for the degree of subsidization is a difficult task, since subsidies may take different forms. There may be preferential loans; assets (like land) may be given to the port at a price below the market price; the port may be exempt from national or local taxes; there may also be annual subsidies of a predetermined amount; there may be a fixed participation in some port costs (like investment costs); or there may even be an open-ended subsidy in cases where any loss incurred by the port is borne by the municipality or the central government.

57. Whether or not a port is to be subsidized is a decision to be taken by the country in which the port is situated. There cannot be a general case to be made for or against port subsidies. However, and whatever the reason for the subsidy, there are certain consequences which flow from the giving of a subsidy, and some possible disadvantages which may ensue. In particular, it needs to be noted that port users are usually partly nationals and partly foreign enterprises, and one consequence of subsidy is therefore that part of any expected benefit may accrue to the foreign users.

58. To admit that any deficit of the port will be covered by a governmental subsidy may be dangerous, since it reduces the incentive of the port management to operate the port efficiently. If subsidies are to be given, their disincentive effects can be avoided by the establishment of fixed rules in allocating subsidies, for instance, in financing part or the whole of some port investment (mainly infrastructure) because it is indivisible, very costly and of long life. Furthermore, in financing part of the port infrastructure, the government ensures a better co-ordination of ports.

59. Another possible disadvantage of subsidizing ports is that port users may use the port assets uneconomically, since the prices charged are generally established at a lower level than in a non-subsidized port. As a result, port users may quickly adopt bad practices which will be difficult to eliminate when necessary. For example, it is not uncommon for ports to receive land free, and hence the economic cost of using land for port purposes may be underestimated by port authorities, which may fix the level of some charges, such as those for open storage, at a very low rate. Port users may decide to benefit from such a policy by leaving their cargo inside the port as long as possible, storage being less expensive inside than outside the port. As a result, the port may become short of storage space and become congested. A solution to this problem may be difficult to find, since after this practice has been going on for some years, there may not be enough alternative possibilities for storage outside the port.

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[22] See S. Johnson, *loc. cit.*, p. 286, para. 34.

[23] See *A comparison of the cost of continental and United Kingdom ports: A Report to the National Ports Council by Touche Ross & Co.* (London, National Ports Council, January 1970). See also "Financing port construction improvements and maintenance", *Second International Port and Harbor Conference,* Los Angeles (Calif.), 7-10 November 1955 (Los Angeles, Board of Harbor Commissioners), pp. 42-47.

Chapter III

PRICING SYSTEMS

60. According to the nature of its administrative and financial statutes, each port should adopt a pricing structure properly designed for the best achievement of the port-pricing objectives within the existing constraints. This chapter provides data regarding the main pricing systems applied in the world, and then goes on to discuss the requirements of a sound pricing structure for the achievement of the main pricing objectives.

A. The various pricing systems applied in the world

61. The main port charges applied throughout the world were studied on the basis of a statistical analysis comparable to those previously undertaken. It was based on a representative sample of 104 ports. The information from 55 ports replying to the first questionnaire of the UNCTAD secretariat was supplemented by data from published sources.[24] The following table shows the geographical distribution of the countries or territories studied:

Geographical zones

Central America and South America	15
North America and the Caribbean	11
Western Europe	19
Eastern Europe	5
Middle East	11
Asia and Australasia	18
Africa	25
Total	104

62. Before presenting the results obtained, it is necessary to recall the terminology used. "Port dues" are the charges made for the use of the port facilities as a whole. "Specific port tariffs", on the other hand, are the charges payable by the operator of the ship or the owner of the cargo (or by other users) in respect of a specific and clearly identifiable service.

(1) *Port dues*

63. In all the cases studied, there was a general port due for the use of the port by the ship and the cargo. In 40 per cent of the cases, this was only a single port due, calculated either on the basis of the characteristics of the vessel (35 per cent of cases) or of the cargo (5 per cent of cases only). In 60 per cent of the cases, the general port due was divided into:

(a) A port due calculated on the basis of the vessel's characteristics, which will be called a "port due on ship";

(b) An additional due, calculated on the basis of the cargo carried,[25] which will be called "port due on cargo".

(2) *Specific port tariffs*

64. Only the main specific tariffs will be examined. The basis for their assessment will be analysed in a later paragraph.

Berth occupancy

65. In addition to the port due, a special tariff is applied for the use of berths in 52 per cent of the cases considered, generally computed on the basis of the time during which the vessel remains berthed. Only a few ports (24 per cent of the cases studied) ignore the time factor when calculating port dues on the ship, or berth-occupancy tariffs.

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[24] Annual publications: *Ports of the World,* London, Benn Brothers; *Port Dues, Charges and Accommodation: The Shipowners', Agents' & Charterers' Guide to Ports and Terminals,* London, George Philip and Son.

[25] There is one particular port due which calls for a word of explanation, as it frequently gives rise to confusion. This is the port due calculated on the basis of the goods carried, which is sometimes paid by the ship's representative, and not by the cargo representative. There are two possible explanations for this procedure:

(a) The port authority wishes to exact a contribution from the shipowner, but chooses to base the charge on the goods carried, rather than on the ship. In this case – which is rare – the corresponding port due is therefore usually incorporated in the freight rate.

(b) The port authority wishes to exact a contribution from the cargo owner, but for the sake of convenience, asks the ship's representative to advance the sums due. In this case, the corresponding due will be passed on directly to the importer or the shipper, sometimes increased by a commission. It has been pointed out* that this practice, which is not particularly welcomed by ship's agents, causes confusion among shippers and consignees, who tend to regard this port due as an increment in the freight rate. Other authors,** however, regard it as an attempt to simplify tariffs.

The incidence of these various charges on transport costs will vary, as will be seen later when this particular aspect of the question is considered (see chap. V below).

* ECA, "A report on a preliminary survey of factors contributing to level of freight rates in the seaborne trade of Africa", by S. F. Klinghofer, Shipping Consultant (E/CN.14/TRANS/27 and Corr.1 and 2), part I, para. 38.

** J. R. Sainsbury, "The simplification of port charges", *Proceedings of the Seventh Conference of the International Association of Ports and Harbors (op. cit.),* p. 168.

Aids to navigation

66. In 47 per cent of the cases studied, a specific tariff is applied to ships for aids to navigation, such as beacons, buoys, etc. In some countries, this charge is made once and for all at the first port of call only, when several are involved. This is understandable, for aids to navigation often extend beyond port boundaries to vessels on the high seas. They are thus national (rather than local) in character.

Berthing and unberthing

67. In 57 per cent of the cases considered, a specific tariff is applied for berthing operations, independently of the charges mentioned above.

Pilotage

68. In virtually all cases (97 per cent) a pilotage tariff is levied in addition to the other charges made against the ship. In many instances, the pilotage service is compulsory.

Towage

69. This service is usually optional. Occasionally, the towage tariff is included in another charge such as pilotage, but for the most part, it is separate. A specific towage tariff was found to exist in 81 per cent of the cases considered.

Cargo-handling and storage

70. These two important cargo services are generally subject to a specific tariff. Although the application of the storage tariff does not create any particular problems, apart perhaps, from the notion of the free-time period (see para. 89), the application of the cargo-handling tariff – which must be adapted to the conditions of the carrying contract – is another matter. For this reason, the cargo-handling tariff is often divided into several parts: cargo-handling on board ship, cargo-handling on quay, and additional services.

Other tariffs

71. The charges mentioned above are often supplemented by a number of specific tariffs for well-defined services to the ship or to the cargo. Services to the ship include: fuel, water and electricity supply; telephone, guard service, repairs, rent of equipment, labour supply, etc., while services to the cargo include guard service; use of equipment or special installations, weighing, marking and repacking, etc.

72. In addition to these specific tariffs, some ports levy other tariffs for more general services benefiting all users (ship or cargo). They include charges in respect of: port improvement, dredging, medical service, police, fire fighting, social welfare for sailors, defouling of storage areas, etc. But, generally speaking, the port authorities do not apply these tariffs independently, no doubt in the belief that the corresponding services cannot be dissociated from the general use of the port, which is paid for by the port dues.

73. In view of these different practices, any inter-port comparison of port charges is difficult.

B. The basis for assessing port charges: statistical study

74. The study of this question is based on a statistical analysis of present-day practices in world ports. The same sample will be used as above (see para. 61 above), comprising a total of 104 ports.

Port dues

75. Port dues on cargo are generally calculated on the basis of the volume or weight of the cargo. In some cases, the criterion adopted is the unit used in the ship's manifest. In others, the port authority reserves the right to choose, between the two units of volume or weight, that which yields the highest revenue.

76. The port due on the ship is usually calculated on the basis of the gross or net registered tonnage of the vessel, as shown in the following table, which gives the results of the statistical analysis of the 99 ports in the sample which apply this due. (Of 104 ports examined, 5 do not apply any port dues on the ship.)

Charging basis	*Number of cases*
Gross registered tons	21
Net registered tons	67
Length of ship	5
Other	6
Total	99

77. Of the above 99 ports, 41 apply a port due on the ship with a time factor included. This time factor may be also incorporated in berth occupancy charges. However, 25 ports, of which 10 are in Europe, do not take the time factor into consideration at all.[26]

78. For charges which are based on the gross or net tonnage of the vessel, which, in addition to the port dues on the ship, include many of the specific port tariffs examined later, there are two basic methods of calculating the charge. The first is to express the charge as a rate per ton (grt or nrt), which may vary according to different classifications of vessels by size. The other is to classify vessels in different size-categories and apply a fixed charge per vessel for all vessels in the same size-category. Both methods are widely used.

79. Another factor which became apparent is the concern of many port authorities to prevent any false declaration or mis-declaration concerning the ship's characteristics and more especially its gross or net tonnage. One

[26] It has been considered that any port giving the ship a free period of one month or more (without time-related charge) does not really take account of the time factor.

interesting case worth mentioning is that where the port authority reserves the right to choose between the net tonnage of the ship or half its gross tonnage.

Berth occupancy

80. Such a tariff, when applied, is additional to the port due on the ship. The tariff may be assessed on the basis of either the ship's characteristics or, occasionally, those of the quay alongside which the vessel is moored. For the 54 cases in which this tariff arises in the sample studied, the following bases of calculation were obtained:

Charging basis	*Number of cases*
Net registered tons	23
Gross registered tons	10
Length of ship	16
Length of quay	2
Other	3
Total	54

81. The time factor is often taken into account in the tariff definition. In 34 of the 54 cases, the tariff was calculated on a daily basis according to occupancy. In another 13 cases, the length of occupancy was taken into account, but the time unit used in the computation was either longer or shorter than one day. In 7 cases, the time factor was not considered in calculating the tariff.

Aids to navigation

82. The tariff is normally but not invariably assessed on the basis of the ship's size as shown below:

Charging basis	*Number of cases*
Gross registered tons of ship	4
Net registered tons of ship	40
Cargo characteristics	2
Other	3
Total	49

83. In 14 per cent of the cases investigated, the corresponding tariff is charged for a given period (month or year) or for a certain number of visits to the port of the country.

Berthing/unberthing

84. In the 59 ports which had a specific charge for this service, the following charging bases were used:

Charging basis	*Number of cases*
Gross registered tons	15
Net registered tons	12
Length of ship	3
Per operation	21
Other	8
Total	59

Pilotage

85. In the 101 ports studied, the following charging bases were used:

Charging basis	*Number of cases*
Gross registered tons	28
Net registered tons	39
Per operation	4
Draught of vessel	11
Draught and tonnage	6
Tonnage and distance piloted	5
Other	8
Total	101

Towage

86. This tariff is assessed on the basis of either the characteristics of the ship, or those of the tug performing the operation. In the latter case, the tariff is levied per unit of time (hour) or operation, and sometimes it also takes into account the power of the tug used.

Charging basis	*Number of cases*
Tug	
Per operation	12
Per hour	23
Total	35
Ship	
Gross registered tons	32
Net registered tons	10
Total	42
Others	7
Total	84

87. In the above tables relating to berthing/unberthing, pilotage and towage charges, the column "Other" includes special units, such as the carrying capacity of the vessel, the tonnage measures peculiar to certain countries, and some more complex measures incorporating length, width and height of vessel.

Storage and warehousing

88. Precise information concerning the conditions for fixing transit-storage and warehousing tariffs could be obtained in only 50 out of the 104 ports studied in the initial sample. Before examining the results obtained, it is recalled that "transit storage" means the storage of goods in transit sheds or areas. "Warehousing" generally follows transit storage, and the warehousing charge applies to goods which, for various reasons, need to remain longer in the port and are therefore transported to special premises reserved for the purpose.

89. In most of the cases studied, there is a free period during which no charge is made for transit storage. This period usually begins at the end of discharging operations,

in the case of imports, or when the goods are deposited in the storage areas, in the case of exports. For imports, its duration is as follows:

Period for which import cargo is held in transit storage without charge	*Number of cases*
0-3 days	7
4-7 days	16
8-15 days	10
More than 15 days	1
Total	34[a]

[a] Of the 50 ports studied, 9 did not give any information on the free period, 4 make no allowance for a free period and 3 did not indicate the length of the free period.

90. Transit-storage and warehousing tariffs are assessed on the basis either of the area occupied (17 per cent of cases) or of the characteristics of the goods – usually their weight or volume (80 per cent of cases). Sometimes, however, the tariff is applied per package, or depended on the value of the products.

91. After the free period has expired, the tariff usually takes account of the length of stay of the goods in the storage place. The units of time on which these tariffs are calculated vary from port to port, but in 81 per cent of cases the unit is the day. In 22 per cent of cases, the storage charge per unit of time remains constant, regardless of how long cargo remains in storage after the free period. However, in many cases, the charge per unit of time increases with the length of time spent in storage in order to discourage any abusive prolongation of storage.

92. Lastly, it should be noted that some ports rent a part or all of their warehouses or storage areas for long periods. In such cases, a tariff based on area (e.g. square metre) is often applied, and the rental period is often one year.

Cargo-handling tariff

93. It was impossible to analyse this tariff systematically because of insufficient statistical data. Nevertheless, the research carried out showed that the bases used for its calculation were broadly alike; the cargo-handling tariff is usually levied per ton of goods, but cargo-handling firms often reserve the right to calculate the tariff on the volume, rather than the weight, of the goods, if they stand to gain thereby. Sometimes, the criterion adopted is the unit which appears on the ship's manifest. A few special types of cargo such as cattle, are taxed per item.

94. As regards the methods of calculating the tariff, two trends may be noted. Either the rate applied is indicated for each product, or all the products are divided into groups according to various criteria, which often take handling costs into account, and a uniform rate is applied to each group. The latter method is simpler and more common.

C. Requirements of a good pricing structure for achieving pricing objectives and satisfying pricing constraints

95. It is a complex procedure for a port to change its pricing structure, and too frequent changes may be a source of confusion for port users. This is why, as a matter of general principle, the *pricing structure* (number of charges, type of charges, charging base) of a port should be designed to last for many years, although the *level* of each port charge may be modified as conditions change.

96. The pricing structure, therefore, should be so designed as to achieve not only present pricing objectives but also future ones. Any good pricing structure should satisfy at least three main general requirements directly derived from the pricing objectives and constraints; it should

(a) Allow a proper re-allocation of benefits;

(b) Facilitate the comparison between charges and costs;

(c) Contribute to the improved utilization of assets.

Additional requirements will be mentioned later when the supply of and demand for port services are studied.

97. A pricing system properly designed to re-allocate with accuracy each user's benefit would imply having a specific charge designed for each specific user. So elaborate a system is manifestly not practicable. As a consequence, all the user's benefits will not be tapped by port charges. Nevertheless, it is still desirable to classify in the same groups and to apply the same charges to those users having the same characteristics. For instance, instead of applying a flat rate to all ships, it is better to classify ships in categories: within each category would be grouped all ships deriving a comparable benefit from the utilization of the port (e.g. all big ships benefit from an increased draught in the access channel, all passenger ships benefit from the passenger terminal, etc.).

98. Furthermore, such a principle of fixing port charges in order to allow for a proper re-allocation of benefits implies adopting basic unit charges which reflect the benefit to the user (demand characteristics). For instance, in the case of the towage tariff, the advantage of the ship's use of tugs is that the risk of collision and grounding is reduced or avoided. The advantage is then related to the value of both the ship and the cargo transported. As an approximation, however, such a requirement may be satisfied if the charging basis is a function of the ship's size.

99. The second main requirement of a good pricing structure is that it should make possible a comparison between port charges and port costs. This implies grouping port costs in appropriate cost centres[27] specially designed as a base for the corresponding port charges.

[27] A cost centre is an accounting device used for the grouping of those costs which satisfy a given criterion. For more details, see part two, chap. VIII, below.

100. As port charges will also be related to such cost centres, the comparison between costs and charges for a given centre will be facilitated. Equally, comparisons between revenue and costs will be easier when the pricing structure (number of charges, type of charges, charging base) reflects the cost of the service given (i.e. the supply characteristics). Taking the same example of towage, this implies that the charging structure will take into consideration the characteristics of the service provided (e.g. number of tugs, time spent, overtime, etc.). Similarly, according to this requirement, the provision of the quay should be charged on a basis which reflects the quay's characteristics. This requirement and the preceding one (that the price should reflect demand characteristics) can both be satisfied, although they may appear contradictory. For example, towage tariffs may be calculated separately for different types of ship (demand characteristics) on the basis of the duration of the operation and according to different rates for normal working hours and overtime (supply characteristics).

101. The third requirement is that the pricing structure should contribute to the improved utilization of assets. It has already been mentioned that a pricing structure should be established for a long period of time, whereas the rates of charges may be changed more frequently (see para. 95 above). Thus, in determining the pricing structure, not only the present level of the utilization of the port's assets but also future (perhaps more desirable) levels have to be taken into account. The question to be considered is whether those assets needing to be better utilized (either now or later) can be better utilized through the variation of port charges.

102. It may not be possible to achieve this in the case of all assets. An example of an asset which generally may be better utilized, through variations in port charges, is the transit shed. A pricing structure which contributes to the improved utilization of assets requires several conditions to be satisfied, as the examination of the transit-shed example will show. First, there should be a separate tariff for short-term storage of cargo in the transit shed (other operations like cargo-handling being priced separately). Secondly, all the cargo having identical characteristics should be grouped together and charged on the same basis (e.g. cargo having the same stacking conditions). Finally, an appropriate basis of calculation is needed, incorporating the time cargo spends in the transit shed in order to discourage the use of the shed for long-term storage. Such a structure is required even if the present utilization of transit sheds is sound. In such cases, no penalty or discount rate will actually be applied. Any future mis-utilization of transit sheds may be eliminated by marginal changes in the rates applied.

103. Some of the requirements of a sound pricing structure for achieving the above three pricing objectives may be in conflict. However, as has already been seen, the use of composite charges may reconcile the various requirements of a sound pricing structure. Table 9 below gives a concrete example of a possible pricing structure established for a hypothetical port according to the above requirements.

Chapter IV

PRICING AND THE SUPPLY OF PORT SERVICES AND FACILITIES

104. This chapter completes the information on the various factors which need to be considered in establishing port charges. The analysis will be devoted to the supply of port services. After an analysis of the characteristics of this supply, some quantitative data will be provided in order to specify the importance of the various port charges in the port budget. Finally, the chapter discusses the requirements of a good pricing system from the supplier's point of view.

A. Characteristics of the supply of port services and facilities

105. The various facilities and services generally provided in a port have been described in chapter II. Now, they have to be considered and clarified for pricing purposes. It may be argued that in the final analysis any port facility provides a port service and that only port services matter. Nevertheless, in order to follow the practices well-established in ports, the distinction between port facilities and services will be retained.

106. As far as facilities and services are concerned, a distinction can be made between those that are *specific* and those that are *general*. Specific services and facilities are those clearly identifiable and charged for separately. General services and facilities, on the other hand comprise the remainder: they correspond to the general use of the port. A port due is often levied for the use of general services and facilities.

107. The services and facilities provided by a port can be further subdivided into those that are given *(a)* on the seaward side (maritime services), *(b)* on the landward side, and *(c)* at the connecting point.

108. Examples of services and facilities[28] provided on the seaward side are:

General services	*Facilities*
The use of navigational aids	The approach channel
the protected water area	
maritime police	
medical services	Breakwater
Specific services	*Facilities*
Pilotage, towage, berthing/ unberthing	Locks, dock yards, floating cranes

[28] As the distinction between general and specific services and facilities may vary from port to port, the examples given cannot be more than indicative.

109. Examples of services and facilities[29] provided on the landward side, are:

General services	*Facilities*
Surveillance services	Fences
Firefighting	Service roads
Administration	
Specific services	*Facilities*
Cargo-handling on quay	Transit sheds
Storage	
Rent of equipment	Warehouses

110. At the point where land and sea meet, quay facilities are provided for both ships and cargo.

111. It is sometimes useful to distinguish operating equipment from facilities. The indivisibility of facilities, i.e. the size of the units in which facilities are acquired or built, is more pronounced than that of operating equipment. For instance, the building of a berth involves the construction of at least 150 metres of quay (at one time), whereas the acquisition of the corresponding equipment (e.g. forklift trucks) may be spread over a longer period as traffic increases. Other differences are that operating equipment is generally mobile, has a short life (generally less than 20 years) and has a relatively small cost per unit, whereas facilities are generally immovable, have a long life and are very costly. Because in most cases operating equipment is needed in order to provide a port service, only the simple distinction between facilities and services will be made in this study.

112. Specific facilities and services are supplied (and charged for) separately, and each has specific user with a corresponding specific demand. On the other hand, general facilities and services are supplied (and charged for) together. They are not associated with any particular service, nor do they themselves constitute a separate service. Their role is to allow or facilitate the utilization of the port. Each general facility taken on its own may have little or even no value. Together, however, they have the value of creating the port.

113. It sometimes happens that port authorities decide that some specific port services shall be compulsory. Examples of compulsory specific services in some ports are pilotage and towage. Port users who prefer to be free to

[29] *Idem.*

use, or not to use, port services, generally try to avoid carrying the burden of any compulsory measure, particularly when that measure is arbitrary. In general, it is desirable to limit compulsory specific port services to those cases where they increase the safety of the other port users or of port installations. It is for this reason that pilotage and towage may be compulsory.

B. The importance of port charges for the port authority

114. An attempt has been made to assess, on a quantitative basis, the relative contribution of the various charges to port revenue. The task is difficult, however, for frequently the administrative structures differ, and charges which appear to be identical may have a different significance. A certain simplification is therefore necessary. To start with, only the point of view of the port authority will be considered, to the exclusion of that of the other port bodies.

115. First of all, *port dues*[30] were studied and compared, a distinction being made between those calculated on the basis of the characteristics of the vessel, and those calculated on the basis of the characteristics of the cargo. For the sake of simplifying the comparison, the question of who paid the due was ignored. It has already been pointed out that in a few instances there are dues which, although calculated on the basis of the cargo, are borne by the ship's representative and included in the costs covered by the freight rate.[31]

116. The object of the first analysis was to determine how the total sums collected by the port authority under the head of various port dues are distributed between dues on the ship and dues on the cargo.

117. Table 2, which has been compiled on the basis of the replies to the second questionnaire of the UNCTAD secretariat,[32] shows the distribution of port dues on ships and port dues on cargo and their relative contribution to the total port dues.

118. Table 2 indicates that two-thirds of the cases examined fall within the range of 1 per cent on ships/99 per cent on cargo, to 30 per cent on ships/70 per cent on cargo. Although the sample studied concerns only 34 ports, located in different countries, the above seems to agree with the conclusions reached in other studies.[33] It should be emphasized that this analysis was confined to the revenue from port dues only.[34]

TABLE 2

Distribution of port dues between ships and cargo

Percentage of port dues levied on		*Number of cases*
Ship	*Cargo*	
0	100	3
1-10	99-90	6
11-20	89-80	12
21-30	79-70	5
31-40	69-60	4
41-50	59-50	1
51-60	49-40	
61-70	39-30	
71-80	29-20	
81-90	19-10	
91-99	9-1	
100	0	3
		Total 34

Source: Compiled by the UNCTAD secretariat.

119. This first analysis was supplemented by an attempt to assess the relative contribution of the main charges to port revenues – a task which, in view of the appreciable difference in the function of the respective port authorities, necessitated a separate study for each main type of port administration. This study was, likewise, based on the replies to the second UNCTAD questionnaire. A distinction was made between ports where the port authority gives services like cargo-handling and those where the port authority's function is more limited. All the results obtained are given in annex III. They may be summarized as follows. In the sample studied (which is limited to 36 ports of various countries) and in the case where port authorities perform cargo-handling services, the order of importance of the contribution of various port charges to the port authority's budget is: *(a)* cargo-handling tariff, *(b)* port dues, *(c)* storage, *(d)* towage. It should be noted that although cargo-handling permits the earning of high revenue, it also implies high costs.

C. Requirements of a good pricing system from the suppliers' point of view

120. A good pricing system should make it possible to achieve the pricing objectives within the constraints imposed. How this requirement is met was demonstrated in chapter III.

121. Furthermore, a sound pricing system should, ideally, be cheap to build up and operate. Consequently, the pricing structure should be as simple as possible. There are two methods of simplification: one is to reduce the number of charges, the other is to reduce the number of variables in the basis for each charge. Obviously, by reducing the number of charges and the number of variables in the basis for each charge, the net result will be a reduction in the number of variables in the charging system.

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[30] See definition on page vi above (Terminology).

[31] See, footnote 25 above.

[32] See annex II below.

[33] J. G. Baudelaire, *op. cit.*, p. 123.

[34] Although not enough answers are available to study separately developed and developing countries, it would seem from the sample studied that developed countries charge more for the ship (versus the cargo) than developing countries.

122. The simplification and integration of port charges deserve general support.[35] It has often been pointed out that some minor charges cost the port more to collect than the revenue it derives from their collection. Nevertheless, too radical simplification may interfere with the achievement of the pricing objectives. In effect, if the separate charges to ship or cargo were to be replaced by a single composite charge, a fall in the port's revenue might result, because users for some specific services would not accept the burden of a higher aggregated charge. Similarly, the simplification of port charges may hamper the sound utilization of assets, which involves making specific charges (as opposed to consolidated ones) for the asset in question.

123. The extent to which the consolidation and therefore the simplification of charges is likely to be of benefit is illustrated in table 9 below for the case of a hypothetical port.

124. In the choice of the charging basis, ports should select a measure which can be accurately determined. If there is any possibility that the port user may submit (inadvertently or intentionally) wrong figures for the charging basis, the port may suffer a reduction of income. The typical case where some difficulties often arise concerns the calculation of the basis of the charge for the ship. Many ports have found that the various existing tonnage measurements of the vessels allow some scope for uncertainty, and as a result, ships calling at some ports have sometimes produced, from one trip to another, a reduced evaluation of the basis for the calculation of port charges by, for instance, adopting a different system of tonnage measurement.

125. The traditional charging units for ships are expressed either in terms of gross registered tonnage grt, designed to measure the volume of the over-all enclosed space of a vessel which is in turn a measure of the ship's size, or in terms of net registered tonnage nrt, a measure reflecting the vessel's earning capacity.

126. The IMCO Conference on the Tonnage Measurement of Ships (London 1969), gave a new definition of these units (which are called gross and net). As some countries have, in addition, their own regulations on the tonnage measurement of ships, ports are faced with many different figures, and this diversity creates problems for them.[36] Some European countries which met in London in 1971 to study the question favoured the use of grt mainly because grt is less ambiguous than nrt.[37] A recent new trend in the search for a charging basis for ships is the adoption by some ports of the ship's length as a criterion.[38] In effect, the use of the ship's length, properly defined, can eliminate most ambiguities. It has the advantage that if there is any doubt about the figure submitted by the ship's operator, a direct measure can be taken. The ship's length also reflects the characteristics of the ship's demand for most of the port services (e.g. berth occupancy, pilotage, towage, etc.), particularly if the main categories of ships are considered separately. The ship's length also reflects in some cases the cost of providing port services to the ship (e.g. quay). Ports unsatisfied with their present basis of charges for the ship might well consider the use of the ship's length for this purpose.

127. After the unit to be used as the basis for assessing the charge has been established, it would be useful to find a common way of applying it. What seems at first sight the simplest system is to fix a rate per basic unit (i.e. per grt or metre). However, a more widely used system, and in the long run a more practical one, consists of classifying all ships into groups according to their characteristics: e.g. vessels of up to 499 grt, 500-999 grt, etc., or vessels of up to 49 metres, 50 to 99 metres, etc., and then establishing a fixed charge for each group which may be applied without the need for any further calculations.

128. Other important recommendations that may be made with regard to the choice of basic units for assessing port charges include:

(a) adopting in the same port and for similar charges, the same units, (e.g. for cargo-handling on board and on quay);

(b) avoiding the use of any basic unit which necessitates complicated and costly calculations.

129. In this connexion, it would be better to adopt a charging basis that is already one of those included in the documents which are presented by the port users (e.g. ship manifest, bill of lading, etc.) or which may be obtained from a widely circulated publication (such as *Lloyd's Register of Shipping*). As a result, additional operations, such as measuring or weighing, are not necessary – or at least only on a sampling basis and in order to check the veracity of the figures submitted.

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[35] J. R. Sainsbury, *loc. cit.*; F. K. De Vos, "A few principles to apply and mistakes to avoid in preparation of port tariffs", *Proceedings of the Seventh Conference of The International Association of Ports and Harbors, op. cit.*, p. 160.

[36] See V. P. Nadeinski, "Tonnage measurement", *Proceedings of the Sixth Conference of The International Association of Ports and Harbors,* Melbourne, 3-8 March 1969 (Tokyo, IAPH), pp. 145-163; B. Wilson and T. Hunter, "Alternative measurements of the types of vessels calling in British ports in relation to port charges", *National Ports Council Bulletin,* (London) 1972, No. 1, p. 1; "Comments by IAPH members on port charges and tonnage measurement of vessels", *Ports and Harbors* (Tokyo), vol. 17, No. 9, (September 1972), p. 12.

[37] United Kingdom, National Ports Council, *Conference on Port Charges and the Tonnage Measurement of Vessels, London, 12 and 13 May 1971: Summary of Proceedings and Conference Papers* (not for publication).

[38] See particularly the views expressed by those United States ports which adopted such a system in "Comments by IAPH members on port charges and tonnage measurements of vessels", *loc. cit.*

Chapter V

PRICING AND THE DEMAND FOR PORT SERVICES AND FACILITIES

130. Before revising port charges, port authorities should consider the probable reactions of port users, since such reactions will often influence them in their decision to adopt a particular pricing policy. The purpose of this chapter is to provide information on the main features of the port users' demands, to present quantitative data regarding the relative weight of port charges in the costs of port users, and to propose guidelines for the establishment of a set of port charges which could be acceptable to port users.

A. The demand for port services and facilities

131. The demand for the services and facilities of a port arises from the function of the port as a place where goods are transferred from one means of transport to another. Accordingly, it may be appropriate to regard cargo owners as the primary users. On this assumption, ship operators (owners), shippers and inland transport operators may be thought of as the secondary users. However, for pricing purposes it is these secondary users who count, because it is they who require the use of the services and facilities of the port and who pay the appropriate charges to the providers of these services and facilities.

132. So far as the secondary users are concerned, ship operators demand the use of the general and specific services and facilities on the seaward side and also the use of the service provided at the point of connexion between the seaward and landward sides, namely, the quays. On the other hand, shippers and inland transport operators demand the use of the general and specific services and facilities on the landward side and also the use of the services and facilities at the connecting point.

133. The *main demand* of ship operators, shippers and inland transport operators is for the use of the general services and facilities and some of the specific services and facilities which are either compulsory or necessary for the normal utilization of the port. Such a demand is normally inelastic, that is to say, not sensitive to variation in the port charges. Of course, inelasticity has a limit, in the sense that port charges may rise so high that they deter users from using the port. This main demand may vary from one user to another and from one port to another. For instance, towage may be part of the main demand for big ships only, since small ones can manoeuvre unaided.

134. It may be argued that the ship operator's demand is not very sensitive to variations in port charges, mainly because port charges account for only a small part of the total cost of maritime transport. In effect, port charges on the ship in a given port constitute around 15 per cent of the maritime transport costs, as will be seen in the following paragraphs. Hence a 20 per cent increase, for instance, in port charges, would result in only a 3 per cent increase in the over-all cost of maritime transport.

135. Although the main demand for services for the ship or cargo may be considered as globally inelastic, it does not automatically follow that the ship operator and cargo owner are completely insensitive to variations in port charges. In effect, the demand components, namely, the demand for the various port services and facilities priced separately, may be partly affected by changes in the corresponding charges. For instance, high rates may induce port users to shorter their stay (i.e., the stay of a ship at a quay or of cargo in a transit shed). However, such alterations in the main demand are generally marginal.

136. The demand for the use of the rest of the specific services and facilities is the *complementary* demand.[39] This demand is price elastic. The complementary demand calls for services intended to improve the quality of the user's passage through the port. For instance, some cargo owners require services like the repackaging of parcels, weighing and warehousing, which enhance the quality of the service rendered to their products. In most cases, such additional services could also be performed outside the port.

137. Independently of the above distinction between main and complementary demand, the demand for services for the ship and for the cargo has some other characteristics worth examining. In particular, the demand for services for ships may be influenced by the way in which the cargo owners or shippers operate and/or by the way the ships themselves operate. If cargo owners or shippers bulk their shipments and/or ships change from half-load to full-load services, for example, this demand will fall even though the volume of cargo shipped may remain unchanged.

B. Who pays port charges?

138. Sometimes there is controversy regarding liability for those charges which correspond to the services provided

[39] The main demand of the ship operator may be, for instance, for use of the protected water, pilotage, towage, berthing, and loading and unloading cargo; other services, such as bunkering, repairs, etc., form the complementary demand.

at the connecting point, such as quay cranes or cargo-handling tariff. Port authorities generally prefer to designate some person as responsible, for instance the ship's agent, and to ignore how the charges collected by the port are shared between the cargo and the ship's representatives. However, it is necessary to know who pays for port charges and how these are integrated in the transport costs in order to understand the relative weights of port charges for the different port users.

139. There is a wide range of contracts of carriage and each of them may provide specific regulations on the subject. Some basic comments concerning port charges may, nevertheless, be made with regard to three types of shipping contracts: time charter party; voyage charter party; and liner bills of lading. As far as vessels on time charter are concerned, all port charges levied are generally paid for by the charterer and not included in the freight.[40]

140. As regards vessels on voyage charter, all port dues and other charges in respect of the vessel – whatever the basis of their calculation – are generally paid for by the owner and included in the freight rates, and all dues and charges on the cargo – not pertaining to that part of loading and discharging operations which is for the vessel's account under the charter term – are generally paid for by the charterer.[41] But in some cases difficulties may arise with regard to the sharing of port charges between shipowners and shippers, mainly in cases where either the definition of the port charges or the transport contract clauses are ambiguous.[42]

141. As far as liner vessels are concerned, port dues and other charges relating to the vessel's reaching, lying at and leaving berths, as well as the tariffs for loading and discharging operations,[43] are often borne by the shipowner and included in the freight rate, whereas charges for landing, storing and delivering cargo are normally borne by the cargo owner.[44] In practice, the liner terms vary from port to port, and not uncommonly charges relating to transport of cargo between ship and shed at loading and discharging ports are borne by the shipowner and included in the services covered by the freight charges. However, there is a recent trend to modify such practices and to revert to a liner-term definition, which does not include these operations on the quayside. Some difficulties have arisen, however, in cases where as a result of this new trend, shipowners have asked cargo owners to pay, in addition to the freight computed on the old basis, pre- or post-shipment charges covering operations on shore. In effect, such new charges, if added to *non-reduced* freight rates, imply an increase in the cargo transport cost.

142. Finally, in certain cases, undifferentiated port tariffs may be levied on the two parties (ship and cargo) in a fixed proportion. As an example, the tariff levied for the use of quay cranes may be shared, in case of "sous palan" agreements, by ship and cargo in proportions such as two-thirds and one-third.

143. As pointed out by L. Baudez, these charges against the ship and against the cargo may not have the same incidence on transport costs. "Charges affecting cargo have a more direct and immediate impact on port traffic because they fall directly on the transport costs payable by the shipper, whereas charges borne by the ship are payable, in the first instance, by the shipowner. For the shipowner, however, port charges represent only a part of total costs. He may, if he deems fit, increase ocean freights correspondingly . . . In any event the reaction of the shipowner will be cushioned and slower."[45]

C. The weight of port charges for the port user

144. In order to provide quantitative data on this subject, two separate statistical studies were conducted, one for the charges borne by the ship's representative and the other for those borne by the cargo representative.

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[40] For example, in the uniform time-charter of the Baltic and International Maritime Conference (BIMCO), (code-name, *Baltime 1939*), paragraph 4 reads "The Charterers to provide and pay for . . . port charges, pilotages (whether compulsory or not), canal steersmen, boatage, lights, tug-assistance, consular charges (except those pertaining to the Master, Officers and Crew), canal, dock and other dues and charges, including any foreign general municipality or state taxes, also all dock, harbour and tonnage dues at the port of delivery and re-delivery (unless incurred through cargo carried before delivery or after re-delivery), agencies, commissions, also to arrange and pay for loading, trimming, stowing (including dunnage and shifting boards, excepting any already on board), unloading, weighing, tallying and delivery of cargoes, surveys on hatches, meals supplied to officials and men in their service and all other charges and expenses whatsoever including detention and expenses through quarantine (including cost of fumigation and disinfection)."

[41] For example, paragraph 5 of the BIMCO General ore charter party 1962 (code-name, *Genorecon*) reads "Dues and other charges levied against the cargo shall be paid by the charterers and dues and other charges against the vessel shall be paid by the owners."

[42] Such difficulties explain the introduction of the new BIMCO Port and Dock Charges Clause (code-name, *Portcon*) presented in the following terms: "A special clause was agreed aimed at covering shipowners chartering their vessels especially to and from ports in the U.S.A. so that they will not be debited with charges such as wharfage, sheddage or any either items which do not actually cover the use which the vessel makes of the port or berth concerned. The clause has been given the above name and the text is as follows: 'At each port of loading or discharging any charge of whatsoever kind or description made by the Port Authority and/or the owner or occupier of any property therein shall be for the Owners' account, howsoever the amount thereof may be assessed, provided only that such charge is made in respect of the Vessel's reaching, lying at and leaving loading or discharging berth, or relates to such part of the loading or discharging operation as may be for the Owners' account under this Charter Party. Otherwise all such charges shall be for the Charterers' account.'" (BIMCO, *Bulletin*, IIIB, No. 256 (Copenhagen, 1971), p. 959).

[43] See J. Bes, *Chartering and Shipping Terms*, 5th ed. (London, Barker and Howard, 1960), p. 15.

[44] See, for instance, paragraph 8 of the BIMCO liner bill of lading (code-name, *Conlinebill*): "Loading, discharging and delivery of the cargo shall be arranged by the carrier's agent, unless otherwise agreed. Landing, storing and delivery shall be for the merchant's account."

[45] L. Baudez, *Economie portuaire* (Antwerp, Edition Lloyd anversois), p. 99.

(1) *Port charges on the ship*

145. The statistical study was made of the disbursement accounts of ships published in the periodical bulletins of The Baltic and International Maritime Conference (BIMCO) for the years 1966-1970. Passenger ships, tankers and ships calling at ports solely for bunkering purposes were excluded from the analysis. Other ships were classified in four groups, by tonnage:

Group I: up to 999 nrt
Group II: 1,000 – 4,999 nrt
Group III: 5,000 – 9,999 nrt
Group IV: 10,000 nrt and over.

146. A systematic study was made of the disbursement account of ships belonging to these four groups, for a large number of countries, calculating in each case:

Port dues[46] on ship in dollars per nrt and per day
Pilotage in dollars per nrt
Towage in dollars per nrt
Berthing/unberthing in dollars per nrt

147. As far as possible, all elements liable to distort the results were rejected. For instance, in the case of pilotage, the comparison was confined to sea ports, to the exclusion of river or estuary ports. Table 3 reproduces the average values obtained for the main port dues and charges on the ship. They are expressed in dollars per nrt of ships (and per day in the case of port dues).

148. Two points may be noted in table 3:

(a) Port dues per tonnage unit of the ship *(and per day)* are almost constant, regardless of the size of the ship;

(b) Pilotage, towage and berthing/unberthing charges per tonnage unit of the ship decrease with the increasing size of the ship. This phenomenon may be attributable to the fact that the cost of the corresponding services depends only to a small degree on the size of the ship.

The amount of port-to-port variation was, moreover, found to be quite small. All the corresponding results are given in annex III.

[46] Including berth-occupancy tariff.

149. It would have been useful to compare the port charges applied in developed countries with those of developing countries. Such a comparison was, in fact, attempted and seemed to indicate that developing countries charge the ship slightly less than do the developed countries. However, in view of the paucity of the information available, it was impossible to assemble samples large enough for the results to be conclusive.

(2) *Port charges on the cargo*

150. The highest charge against cargo is the tariff on cargo handling. However, any comparison between one port and another is difficult, as the services covered are not the same and calculation methods differ. Even within the same port, the cargo-handling tariff varies, sometimes considerably, from one product to another. Nevertheless, in order to assess the level of this charge, an analysis covering 18 developing countries was carried out. In most cases, the total charge for handling general cargo in the port, including discharging and loading the ship, was between $2 and $8 per ton (where a ton may be either a weight ton, or the greater part of a weight ton or a measurement ton).

(3) *Port charges, transport costs and prices of products*

151. The different port charges form part of the aggregate costs of transporting products moving through the port. Consequently, it is interesting to view them against the background of these costs. The following information will be useful in this context.

152. Several authors have attempted to compare port dues and charges with the costs of transport and the prices of the products, but the task is a difficult one, for several reasons. First, such comparisons only make sense for a given product, a given type of ship and for a well-defined route, for although ocean freight rates may be sometimes comparable for routes of different lengths, it is very difficult to compare costs for complete journeys by sea and by land, as land costs may vary considerably. Moreover, it is clear that the prices of the products themselves will vary widely either at the production or selling stage. Another

TABLE 3

Level of the major port charges on ships

Tonnage group	*Port due on ship per nrt and per day*	*Port tariffs on ship per nrt*		
		Pilotage	*Towage*	*Berthing/ unberthing*
Up to and including 999 nrt .	0.13	0.22	0.16	0.07
1,000 - 4,999 nrt	0.10	0.10	0.10	0.03
5,000 - 9,999 nrt	0.10	0.05	0.07	0.02
Over 10,000 nrt	0.10	0.05	0.08	0.02

Source: Compiled by the UNCTAD secretariat from data in BIMCO periodical bulletins during 1966-1970.

difficulty arises from the different methods of calculating the charges against the ship, (the adoption of totally different units, such as the tonnage or length of the ship, cargo carried or length of quay used), or against the cargo (volume, weight, etc.).

153. Accordingly, it is impossible to make any direct comparison between these partial transport costs, and recourse must be had to less precise figures such as those relating to an average ship, loading or discharging a given tonnage of mixed cargo, etc. Rather than carry out new calculations of this kind, therefore, it was thought preferable to make a synthesis of previous studies carried out in this field. The study is confined to liners.

154. The freight rates of regular liners incorporate a number of costs, including port dues and tariffs on the ship and, in general, stevedoring costs. It has been estimated that stevedoring costs are about five times as great as the port dues on the ship,[47] although this estimate must be regarded cautiously as the divergences in this case are extremely wide.[48]

155. The total of the port charges on the ship can be determined fairly accurately as they appear in the disbursement accounts of ships, alongside other expenses such as shipping agent's commission. According to the various authors,[49] these port charges, at both ends of the route, represent approximately from 20 to 30 per cent of the costs included in the freight.

156. Purely to give an easy-to-remember indication of the order of magnitude of the various costs in the total sea-freight cost, figure 3, which could be valid for a medium-sized cargo liner for a deep-sea route of average length, has been constructed. If the total freight cost, excluding shorehandling, storage and other charges on cargo were $45 per ton, about $15 of this sum might be incurred on the sea leg and $15 in each port. Of the $15 in each port, charges might account for about $5 and the cost of the ship's time for the remaining $10. Of the total port charges of $5, port dues, pilotage, towage, etc., might constitute about $1.7 whilst stevedoring and tallying would account for the remaining $3.3.

157. In addition to the above sea-freight costs, other charges on the cargo, such as storage, shorehandling and other charges, are also included in the costs of transport. These port charges on the cargo are, in general, greater than the port charges borne by shipowners (e.g., although stevedoring tariffs together with other port charges on the ship may amount to about $3 to $5 per metric ton of cargo loaded or unloaded, other charges on the cargo, such as those for cargo-handling, storage, weighing, etc., can be two or three times this figure.)

158. Tables 4 (p. 31) and 5 (p. 32) demonstrate more clearly the divergences and lack of precision of any general estimates in this field.[50] Both these tables have the further merit of showing all port charges in relation to the price of products.

These tables show clearly that port charges represent only a small percentage of the value of the products carried, particularly of high-value goods.

D. Requirement of a sound pricing structure from the users' point of view

159. Port users appreciate pricing systems that are clearly understandable and comparable as between one port and another. Actually, because of the existing diversity of the various pricing systems and of the bases for calculating port charges throughout the world, any comparison between one port and another is difficult. If port charges were calculated on identical or comparable bases (as simple and lucid as possible), users would be able to assess the amount of the various charges more accurately, and so reduce the margin of uncertainty in their estimates. Incidentally, port authorities also have an interest in adopting comparable, if not identical, bases for calculating charges, for they would then find it easier for them to evaluate their competitiveness with regard to other ports.

160. Some countries have clearly understood the advantages of a standard pricing structure and have established common methods of calculating charges for all their ports, sometimes with different rates which are left to the discretion of the local authorities. But entrenched practices and the relationship of certain port charges to other transport charges, such as ocean freight, may hamper progress towards common bases for the calculation of charges. Moreover, a number of problems arise in this connexion which sometimes stand in the way of any attempt at standardization. One of them concerns the choice of common units of measure. In effect, the existence of two measurement systems adds to the difficulty of comparing the charges of countries with different systems. For example, although the difference between the metric ton and the Anglo-Saxon long ton is only 1.6 per cent (one long ton = 1016.047 kg), the difference between the comparable units of volume (1 cu m and 40 cu ft) is 13.3 per cent (one freight ton = 40 cu ft = 1.133 cu m). In

[47] A. S. Svendsen: "Does the traditional set-up of port charges favour old and unmodern ships? " Paper submitted to the Conference organized by the Norwegian Shipping Research Institute: "The change to unitized cargo and the general cargo part", Oslo, 4 October 1966.

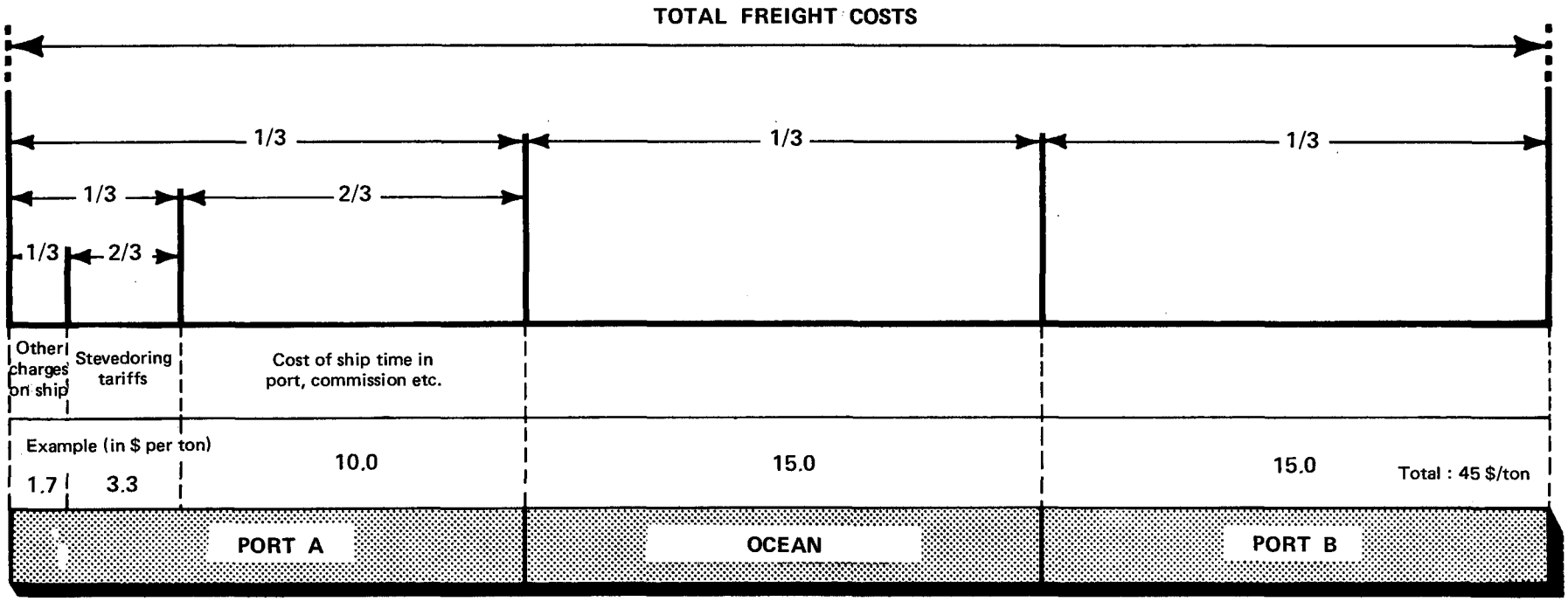
[48] See OECD, *Ocean freight rates as part of total transport costs* (Paris, OECD, 1968), paras. 5 and 24.

[49] D. Shoup, *Ports and economic development* (Washington (D.C.), The Brookings Institution, September 1967), p. 99; J.G. Baudelaire, *op. cit.*, p. 98; OCDE, Ocean freight rates as part of total transport costs, *op. cit.*, para. 36; ECA, "A report on a preliminary survey of factors contributing to level of freight rates in the seaborne trade of Africa" *(op. cit.)* part I, table 8, and part II, table 22.

[50] See also: *The turn-around time of ships in port* (United Nations publication, Sales No. E.67.VIII.5).

FIGURE 3

Port charges on ship as a proportion of sea freight cost
(The one-third rule)



NOTE : This simple diagram has been conceived by the UNCTAD secretariat to give an indication only of the order of magnitude of the costs involved.

TABLE 4

Port charge to consignee and assumed share of ocean freight, as port charge to shipping lines, as a percentage of wholesalers' cost for selected commodities at selected West and Central African locations, 1964

Location	*Commodity*	*Consignee's port charge*	*Shipping line port charge*	*Port charges at destination as percentage of total cost*
Dakar	Piece goods . .	.04	.10	.14
	Piece goods . .	.06	.02	.08
	Piece goods . .	.32	.19	.51
	Piece goods . .	.22	.55	.77
	Enamelware . .	2.57	1.57	4.14
Bathurst	Cement	5.56	4.73	10.29
	Bicycle covers . .	.46	1.21	1.67
Monrovia	Trucks, boxed . .	.56	.90	1.46
	Cars, unboxed . .	1.00	2.01	3.01
Lomé	Wax-printed cotton	.56	.42	.98
	Cement	12.99	3.92	16.91
	Cement	9.64	2.69	12.33
Douala	Iron sheets . . .	1.50	.58	2.08
	Trucks	1.13	.57	1.70
Libreville	Sugar, cartons . .	2.46	.38	2.84
	Beer, cartons . .	3.58	.76	4.34
	Piece goods, cotton	.46	.17	.63
Pointe Noire	Iron sheets . . .	2.15	.64	2.79
	Mineral water . .	4.93	.92	5.85
Brazzaville	Beer	2.61	.96	3.57

Source: D. Shoup, Ports and Economic Development *(op. cit.)*, p. 101, table V.1.

order to avoid such difficulties, there is now a trend favouring the adoption of the metric system in various fields, including shipping and ports.[51]

161. The present great diversity in port charges has been so keenly felt that voices have begun to be raised in favour of the harmonization of port charges.[52]

162. The lack of uniformity is not the only obstacle which the port user has to overcome in understanding how port charges are calculated. As a matter of general principle, it is desirable to explain clearly each charge, specifying which services are included and which are excluded. For instance, in the case of storage tariffs, the point in time from which the free period (if any) begins to run should be clearly stated. The end of cargo discharging might be a useful criterion, for it is simple to apply and not open to possible complaints.

163. Port users would like to see a pricing structure which takes into account the constraints which arise from their working practices. For instance, depending on the terms of the transport contract, the costs of cargo-handling on board, those of cargo-handling on quay, those of providing additional services like quay cranes, may be borne by different bodies. A port pricing structure which clearly separates these three services will help them in allocating the corresponding costs to the body which has to bear them.

164. Port users require a pricing system which is as stable as possible and appreciate being informed well in advance of any price change, in order to have time enough

[51] "In compliance with the decision of U.K. Ports generally, the Port of London Authority will change to metric units as the basis for its charges on goods on 1 January, 1973. Rates will be quoted per ton (1,000 kg) or per cu m as appropriate." See, "Charges in metric units", *Ports and Harbors* (Tokyo), vol. 17, No. 2 (February 1972), p. 41.

[52] See the report of the Reunión conjunta de autoridades portuarias y usuarios del transporte marítimo centroamericanos (Joint meeting of Central-American port authorities and users of shipping), San José (Costa Rica), 4-6 March 1971, topic No. 2 (mimeographed) (Spanish only); D. Shoup, *op. cit.*, p. 143; *Second Triennial Conference of the International Association of Ports and Harbors: Report of Business Proceedings*, Mexico, 22-25 June 1959 (Tokyo, IAPH), pp. 37, 61 and 62; Statement by Mr. J. Chapon, to the first General Assembly of the Comité de coordination des ports de la Méditerranée nord-occidentale (Co-ordinating Committee for North-West Mediterranean Ports), *Journal de la marine marchande et de la navigation aérienne* (Paris), 54th year, No. 2754 (28 September 1972), p. 2473; B. Nagorski, *op. cit.*, pp. 228 and 229.

TABLE 5

Port charge to shippers and assumed share of ocean freight which is the port charge to shipping lines as a percentage of the overseas c.i.f. price of selected West and Central African countries, 1963, 1964

Location	*Commodity*	*Shipper's port charge*	*Shipping line port charge*	*Port charge at origin as percentage of total c.i.f. price*
Sierra Leone	Palm kernels . .	1.95	1.51	3.45
	Cocoa	.66	.64	1.30
	Ginger	.69	.58	1.27
	Coffee	.75	.91	1.66
Ghana	Cocoa	.67	.35	1.03
	Cocoa	.67	.54	1.21
Dahomey	Groundnuts, decorticated . .	1.27	1.21	2.48
	Palm oil in bulk .	1.16	1.30	2.46
	Cotton	.81	.61	1.42
Cameroon via Douala	Palm kernels . .	1.34	1.45	2.79
	Cocoa	.42	.36	.78
	Coffee	.27	.37	.64

Source: D. Shoup, *op. cit.*, p. 103, table V.2.

to modify their behaviour, if judged necessary. The publication of port charges, before their entry into force, has been recommended by the 1923 Convention on the International Régime of Maritime Port.[53] Another principle, also endorsed by the same Convention, is the equality of treatment amongst port users.[54] It goes without saying that port users will object strongly to any increase in port charges with a retroactive effect.[55]

[53] Convention and Statute on the International Regime of Maritime Ports, and Protocol of Signature, Geneva, 9 December 1923, League of Nations, *Treaty Series*, vol. LVIII, p. 287.

[54] Article 2 of the Statute requires each contracting State "... to grant the vessels of every other Contracting State equality of treatment with its own vessels ... The equality of treatment ... shall cover facilities of all kinds, such as ... as well as dues and charges of all kinds ..." (*Ibid.*, page 301).

[55] See BIMCO *Weekly Circular* (Copenhagen), No. 45 (4 October 1972), p. 4.

Chapter VI

COSTS, BENEFITS AND REVENUE FLOWS

165. After the foregoing discussion of the practical questions involved in port pricing, it is now possible to return to the more theoretical issues touched on in chapter I. Here, the importance, for pricing purposes, of identifying and analysing flows of costs, benefits and revenue was pointed out. The aim of this chapter is to provide further information on these subjects. In addition certain questions of definition were left aside in chapters II to V in order to concentrate on the practical issues, and these are covered here. Thus this chapter brings together a number of points, all fundamental to the study of port pricing, but not necessarily related in any other way.

A. The flow of costs in a port

(1) *Nature of the cost*

166. The provision of port services and the provision and maintenance of the facilities create a flow of costs for the port entity concerned. These costs are of two different kinds. First, there are the *once and for all costs,* represented by the outlays required to buy a piece of capital equipment, build a new quay or dredge a channel. Second, there are the costs which continue and constitute a continuous outward flow: these costs are accounted for by such items as wages, power to operate machinery, maintenance of equipment, quays or dredged channels. The once and for all costs can be converted into an annual flow of costs through depreciation or amortization charges. They can then be added to the recurring costs to produce a flow of total annual costs.

167. The second useful distinction to be made as regards port costs is that between the *fixed* and *variable* ones. The fixed cost of a service or facility is that part of the cost incurred which cannot be avoided, whether or not the service or facility is used. Hence a fixed cost is often referred to as an unavoidable cost. For example, if a payment is committed for a period of five years, then that cost is fixed for the whole of that five-year period, since whatever happens – whether or not there is traffic or whether or not the corresponding service is used – the cost remains and cannot be avoided. An example of a fixed cost is the annual interest charge on capital tied up in an investment.

168. The variable cost of a service or facility, on the other hand, is that part of the cost which is avoided if that service or facility is not used. An example of a variable or avoidable cost is the cost of electricity in the case of electric quay cranes, since there is no electricity cost if the quay cranes are not used.

169. It should be noted that a cost is fixed or variable with reference to a particular time period. Thus, if the time period considered is sufficiently long, all costs become variable. The budget period of a port, generally one year, is a useful base for considering the distinction between fixed and variable costs. In effect, the adoption of a budget implies commitments of labour and capital expenses and gives useful indications for determining the amount of the fixed costs in the port.

170. As far as the assets of a port are concerned, a distinction can be made between those that are *renewable,* i.e. subject to depreciation, and those that are *non-renewable,* i.e. not subject to depreciation. An example of a renewable asset is a crane, and an example of a non-renewable asset is land. The annual capital cost of a non-renewable is the annual interest charge on the asset. In the case of a renewable asset, the annual capital cost includes, in addition to the annual interest charge, the annual depreciation charge.

171. As regards *renewable* assets, there are those which are subject to time-depreciation (time-depreciated assets) and those which are subject to use-depreciation (use-depreciated assets). A time-depreciated asset is one whose economic life is determined primarily by the passage of time, for example, a breakwater which is damaged by weather or the sea, independently of how many ships use the port. On the other hand, a use-depreciated asset is one whose economic life is determined mainly by wear and tear arising *directly* from the use of the asset, e.g. land surfacing. In devising a port-pricing system, any asset whose economic life is subject to obsolescence may be considered as a time-depreciated asset. Because of the rapid changes now occurring in shipping and port technology, some assets which may appear to be physically non-renewable or to have a very long life, like breakwaters, quays, etc., may be classified as renewable assets subject to time depreciation.

(2) *The generation of costs at a port*

172. By analogy with the division of the services into general and specific, it is useful to distinguish between those costs which are associated with general services and those which are associated with specific services.

173. For pricing purposes, any cost which may be associated without arbitrariness with a specific service priced separately, will be called a *specific* cost. And any cost which cannot be associated with a specific service will be called a *general* cost.

174. According to the above definitions, any specific or general cost may be either fixed or variable. Such a statement requires additional comment, since it may appear unorthodox to have general variable costs. However, it should be noticed that, for pricing purposes, some costs are considered as general costs only because the corresponding services are not priced separately, and irrespective of whether they are fixed or variable. For instance, if the pilotage service is not priced separately but is consolidated with port dues on a ship, then any variable cost for piloting the ship to the port (e.g. diesel oil for the pilot boat) will be a general cost. It is clear from the above remarks that the definition of specific or general costs may differ considerably from port to port.

175. As was done for the general facilities and services, it is also possible to divide general costs into two groups: those which are on the maritime side and those which are on the landward side. For cost control, it may also be desirable to separate those general costs which are purely administrative from those which are operational.

176. Port costs, either specific or general, need to be properly identified and allocated to the corresponding cost centres. A cost centre is an accounting device for the grouping of those costs which satisfy a given criterion. One or several cost centres will form, in turn, a revenue centre, this being an accounting device grouping all revenue of the same nature. Practical guidelines are provided in chapter VIII.

(3) *The calculation and analysis of costs*

177. The basic problem in the calculation of costs is how to convert capital expenditure which occurs at a point in time into a flow of costs over a period of time. Accordingly, in this section, the problem of converting a fixed outlay into a flow of costs will be discussed in relation to the one-year budgetary period, i.e. the problem of calculating annual capital costs. The one-year period is chosen because it conforms to normal accounting practice.

178. In order to calculate the annual capital costs, it will be necessary to decide:

(a) Which of the capital assets are to be taken into account in the calculation and which are not;

(b) Which of the assets to be taken into account are subject to depreciation and which are not;

(c) What value to attach both to the assets which are not subject to depreciation and those which are;

(d) How and over what time period to depreciate those assets which are subject to depreciation.

These four problems will be examined in turn.

179. Logically, all facilities or equipment which do not contribute to the quality or level of the service of the port, such as redundant and obsolete assets, should be excluded from the calculation. Nevertheless, it may happen that some redundant assets give rise to costs for the port authority in ensuring that they do not cause damage to other useful assets in the neighbourhood. For example, some obsolete quays or breakwaters may have to be maintained so that they do not collapse into a deep-water channel. (To demolish them may cost more than to maintain them.)

180. As regards the second problem, there is no general agreement on what constitutes the non-renewable or the renewable assets in a port. According to a survey carried out by the UNCTAD secretariat, land is the only asset which most ports treat as a non-renewable asset. The practice with regard to assets such as land-surfacing, breakwaters and dredged channels varies; while, in some cases, they are not subject to depreciation, in many other cases they are considered to be subject to depreciation (see table 6).

TABLE 6

Depreciation practices for various different kinds of assets

	Percentage of sample subject to depreciation
A. Assets *not* subject to depreciation generally[a]	
1. Land	0
2. Landfill	21
B. Assets subject to depreciation generally[a]	
1. Locks	80
2. Quays	79
3. Floating equipment	91
4. Cranes: quayside/gantry/mobile	95
5. Trailers/tractors/forklifts	96
6. Buildings	94
7. Warehouses/sheds	91
8. Installations (telephone, electricity, etc.)	80
C. Assets for which the practice varies considerably	
1. Breakwaters	71
2. Surfacing of land	64
3. Dredging	61

Source: Survey carried out by UNCTAD secretariat.

[a] Defined as 75 per cent or over of the sample.

181. The third problem is what value to attach to the assets which are to be included in the calculation. This problem is discussed first in relation to non-renewable and then in relation to renewable assets.

182. In the case of non-renewable assets, the first question which needs to be asked is: have these assets a real economic value? In other words, does an alternative use exist for them? Of the non-renewable assets, land is,

perhaps, the only asset with a real value. Assets like a dredged channel usually have no alternative use and therefore no economic value. Similarly, landfill may often be considered as having practically no alternative use since it would be too costly to recuperate it for another use. In economic jargon, the costs of such assets without alternative use are "sunk" costs.

183. In treating the non-renewable assets, it is desirable to limit their number to those which are definitely non-renewable by reference not only to their physical life but also their economic life. (For example, a 30-feet dredged channel may have an infinite life; yet it could become obsolete if the port needed to accommodate vessels requiring a greater depth of water.) As a result, land may appear as the only non-renewable asset of the port and the task will be reduced to evaluating the economic value of land. In most cases, the real value of land can be obtained by comparison with the market value of land in the port neighbourhood.[56]

184. In the case of renewable assets, it is quite common to use the original costs or the book value for calculating capital charges.[57] That may not be a satisfactory method when historical costs do not reflect the asset's real value. Furthermore, in some cases, historical costs are difficult to trace. When possible, it would be preferable to estimate the current real value of the assets by reference, for instance, to the second-hand market for assets, such as forklift trucks, tractors, cranes, etc. However, in some cases, it may be impossible to discover either the real value or the historical cost. The current replacement costs of the asset concerned may be used, but some care is necessary in dealing with this, as is shown in annex V, where this problem is examined in depth.

185. As in most countries prices are rising constantly, the valuation of assets is generally supplemented by an estimation of, and hence a provision for, the difference between the future replacement costs and the original or current cost. Obviously, if a port wants to be able to replace its renewable assets when due without running into a deficit, then an allowance must be made for price increases due to inflation. This provision may be calculated for each individual asset or for groups of similar assets, e.g. a group of quays. Examples of provisions for price increases are given in annex V.

186. The fourth problem is how, and over what time period, to depreciate those assets which are subject to depreciation. There are several methods for the estimation of the annual asset depreciation, which is the annual loss of value of the asset during the year considered. Such methods give either constant annual depreciation over the asset's life (e.g. straight-line method) or a decreasing annual depreciation. However, in all cases, it is possible to estimate the asset's net value (original cost less accumulated depreciation) and to calculate the annual capital charges in respect of the asset. These are made up of the annual depreciation plus the interest cost on the asset's net value. If the original cost reflects the real asset value and the depreciation is correctly estimated, this method gives satisfactory figures.

187. There is another way of calculating capital charges, which is more interesting for pricing purposes, namely, the amortization method. If the asset value and its period of life is known, the amortization method financially amortizes at compound interest the asset value over its life, without estimating year by year the real depreciation. This method gives constant annual capital charges made up of a constant annual interest on the original value plus a constant annuity for the capital amortization. The figures obtained, being constant, are particularly appropriate for pricing purposes. Of course, it is also necessary here to have a good estimate of both the asset value and of its period of life at the time when the level of annual charges is calculated. The various methods for calculating capital charges are described and analysed in annex V, where it is suggested that the amortization method is preferable for calculating the capital charges of the most important port assets, although the so-called "straight-line method', which is simpler is satisfactory enough for the less important ones.

188. Whatever the method adopted, care should be taken to avoid some common mistakes. The first is to confuse two methods, i.e. to take the depreciation from one method and interest charges from another. The second is to add capital charges and loan reimbursement: this is double counting. The third is to take interest on loans as the interest for the capital charge: this gives wrong figures when the period of a loan and the life of the asset differ. Examples of capital-charge calculations are also given in part two and in annex V.

189. As to the depreciation period, a survey conducted by the UNCTAD secretariat covering 38 ports has shown wide variations in the depreciation periods chosen for similar assets. For example, the period of depreciation for concrete quays ranges from 20 to 300 years.[58] The vast divergences found were certainly a reflection of widely diverging fiscal needs and/or depreciation policies rather than of vastly different economic lives of similar assets. The

[56] It was not uncommon, some years ago, to under-evaluate land value in ports. A more realistic attitude appears today which emphasizes scarcity (and therefore cost) of the area when land meets water. See: H. A. Mann, "Why comprehensive port planning? ", *Ports and Harbors* (Tokyo), vol. 17, No. 11 (November 1972), p. 7.

[57] According to the survey carried out by the UNCTAD secretariat, 54 per cent of the respondents to its second questionnaire (see annex II below) stated that they used the original or historic costs, 14 per cent the present replacement costs and 3 per cent the future replacement costs. The other answers gave no indication, or were ambiguous.

[58] Where an asset is depreciated over more than, say, 60 years, the annual depreciation charge will be insignificant compared with the interest charge.

range embracing the periods of depreciation used by the 38 ports responding to this question is shown in table 7.

TABLE 7

Study of the periods of depreciation for port assets

	Range (excluding extreme values) in years
Breakwaters	50 – 100
Quays: concrete	30 – 80
Quays: steel	20 – 50
Quays: wood	20 – 50
Buildings	20 – 50
Warehouses/sheds	20 – 50
Floating equipment	10 – 20
Quay cranes	10 – 20
Gantry cranes	10 – 20
Mobile cranes	5 – 10
Trailers	5 – 10
Tractors	5 – 10
Forklift trucks	5 – 10

Source: Survey carried out by UNCTAD secretariat.

190. The general comment which can be made in the light of such a statistical study is that some ports are much too optimistic in evaluating the period of life of their assets. Given the probabilities of changes in shipping and port technology, it is prudent to err on the side of short depreciation periods.[59]

(4) *The allocation of costs*

191. All costs which are not directly associated with a given service priced separately, that is to say all general costs, may be allocated to the various specific port services. Before examining how the allocation may be made, it is necessary to be clear that any allocation is arbitrary and that there is no right, and therefore no wrong, allocation of general costs. Broadly speaking, there are two types of methods for allocating general costs to the various specific port services.

192. The first method is to allocate all general costs *pro rata* on some suitable basis such as time, space, number of employees in the service concerned. For example, a general cost may be allocated to the specific services concerned on a *pro rata* basis using the individual specific costs as weights. Notationally, if the general cost is x and the sum of the specific cost is y, then the fraction to be allocated to each of the services is the specific cost of this service multiplied by $\frac{x}{y}$.

193. The second type of method is to allocate non-specific costs on the basis of elasticities of demand, i.e. according to what the traffic can bear. This may take the form of allocating costs *pro rata* with reference to the level of benefits derived by each type of user. Thus, the higher the level of benefits the bigger the allocation, and the lower the level of benefits the smaller the allocation.

194. The major problem when dealing with cost allocation is how to reduce as much as possible the degree of arbitrariness used in the allocation. The typical question is how to allocate the costs generated at the point where land and sea meet (e.g. quay costs) between ship operators (or owners) and cargo owners. Several solutions are possible. The most widely known in ports result from a testimony to the United States Maritime Commission by a consultant on port charges, Howard G. Freas, in 1948. The so-called "Freas Formula" allocates port costs to ship or to cargo *pro rata* on the basis of some cost-related elements.[60]

B. The flow of port users' benefits

(1) *Introduction*

195. Before examining what the main port users' benefits are and how they accrue to them, some definitions have to be made. The first one concerns the distinction between real and net benefits. Real benefits are those which accrue to the users of the port and which come from the creation and improvement of the port. These benefits take the form of financial flows and were defined in chapter I (see para. 4 above). Whatever the pricing policy adopted, real benefits are left unchanged. For example, the real benefit of a reduction of ship waiting time which comes from the construction of a new berth is not affected by increased port charges to finance the berth, nor is the financial gain. What the port charges have done is to reallocate the benefit. Thus, net benefits are those remaining in the hands of the user concerned after he has borne the corresponding port charges. Using the same example as above, if, when a new quay is constructed, port charges tap all the benefits resulting from the reduction of ship waiting time, the port authority and not the shipowner enjoys the benefits created. Since the same charge will be levied on all ships, whether they would have waited or not if the new quay had not been constructed, the tapping of all benefits is in practical terms, unrealistic. None the less, this example exemplifies vividly the point being discussed.

196. There is another useful distinction to be made among the various port users. It was argued earlier (see para. 131 above) that the primary port users are the cargo owners, since the port exists to serve the needs of cargo by transferring it from land to sea and *vice versa*. Although the cargo owner is the primary user of the port, most of the port facilities and services are given to intermediaries (ship operators, inland transporters, etc.) and not to cargo

[59] The lowest figure in the range of depreciation periods indicated in table 7 may be used as a base. However, such a base is only indicative since owing to climatic conditions, working practices and quality of maintenance, etc., the period of life of the same asset is not the same from one port to another.

[60] The "Freas Formula" is presented in annex VI below.

owners. Hence three steps are needed in analysing the flow of benefits arising in a port, namely:

(a) Identification of the benefits accruing directly to intermediaries;

(b) Consideration of whether and how intermediaries pass on their net benefit to cargo owners;

(c) Study of the cargo owners' benefits.

197. Before examining how the flow of benefits arises and is re-allocated in ports, it seems useful to emphasize that, according to the nature and the level of port charges applied to the two main port users – the ship operator and the cargo owner – the level of the net benefit to the user may vary widely. Hence it is important in any port-pricing study to determine the right equilibrium between port charges on the cargo and port charges on the ship. The appropriate solution to this problem calls for, among other things, a knowledge of the extent to which ship operators pass on their net benefit to cargo owners, and of the extent to which both ship and cargo demand are sensitive to port-pricing variations.

198. Before a decision is made on the balance between charges on ships and charges on cargo, reference to present practices in other ports may be useful. Major changes in this balance of charges will not need to be made often; indeed, such modifications will invariably be difficult to make because of resistance from the party expected to bear the greater share of the charge.

(2) *Secondary users' benefits*

199. For the sake of simplification, the example taken to illustrate this point is the case where the port authority renders all port services, the main secondary user being the ship operator (on the seaward side) and the cargo transporter (on the landward side). In between, it will be assumed that all services are given directly to cargo owners by the port authority.

200. The inland cargo transporter will benefit from any general improvements, such as surfacing the service roads, etc. Nevertheless, the corresponding benefits are very often not taken into account or charged for. The picture may be different when there are railways or waterways as inland means of transport. Any port investment devoted to such means of transport will normally improve their productivity: this improvement will be the real benefit.

201. The more important secondary port user is the ship operator. The real benefits to the ship operator arising from port improvements will be reflected in a rise of the ship's productivity, which can take two forms:

(a) a reduction of ship turn-round time in the port (e.g. a new berth or more efficient methods of cargo handling);

(b) savings in the maritime transport costs, because the port can accommodate more productive ships (e.g. a new deeper-water berth allowing bigger ships to call).

202. It is possible to evaluate such benefits. Data regarding the ship's costs in port are available. Equally, the economies of scale arising from the use of larger ships are known, and the savings resulting from using such ships can be estimated. Although the benefits are readily calculable, care is necessary in the evaluation, since actual benefits accruing to ship operators from a port improvement may not bear any obvious relation to the apparent results of the improvement. For instance, if the cargo-handling rate is doubled, it does not necessarily halve the ship's turn-round time in the port. There may be some constraints affecting the ship which cannot be easily reduced, such as bunkering, repairs, change of crew, etc.

(3) *From the secondary users' benefits to the cargo owners' benefits*

203. It might be expected that once the secondary users have paid the port charges, the net benefits they obtain from port improvement would be passed on to cargo owners, through better services and/or a reduction in the price of those services. This should help to reduce the unit transport costs accruing to the cargo owner. In a competitive situation, this would, perhaps, be true. However, if some port users are in a monopolistic position, then net benefits may not be passed on to cargo owners – or may be passed on only after some delay. If the secondary users are nationals of the country in which the port is situated, this failure to pass on benefits may be accepted. Often, however, port users are foreign, and if they fail to pass on benefits to cargo owners, part of the benefits arising from port improvements will leave the country. This is not satisfactory since any port improvement carried out by a country should benefit that country in one way or another.[61] Hence, it would seem desirable, in order to avoid losses, to tap through port charges all real benefits accruing to the ship operator from port improvements.

204. In the case of chartered tonnage the effect of untapped benefits left to the shipowner may be to give an advantage to the country's trade through lower freight costs. In the case of liner tonnage, however, the consequence of the practice of averaging rates over a range of ports is that, if only one of these ports has been improved, that port is subsidizing the other ports of the range. It should also be recognized that, whereas port surcharges may be applied by liner operators to ports which experience a decline in efficiency, no corresponding discount rates are applied to shipments to and from specific ports where ships are served more efficiently. As a result, it appears that, with current shipping practices, there are many reasons for advising ports in developing countries to

[61] Note, however, that a country may be satisfied with indirect benefits. For example, a port improvement which leads to substantial net benefits' remaining in the hands of the shipowners may attract additional shipping services to the port, so that cargo owners gain by more frequent sailings and not by any reduction in freight rates.

leave the net shipowners' benefit at the minimum compatible with the market condition.

(4) *Cargo owners' benefit*

205. Cargo derives an added value from its transportation through the port (see para. 4 above) and the port may, therefore, claim part of that added value. It is clear, for instance, that in an undeveloped forest region trees have practically no value. With the opening up of the country through roads and a port, the timber can be exported and thus acquires increased value. Part of the benefit derived from such increased value may be attributed to the port. The same kind of reasoning applies to the extension of an old port. When a new quay is built, it often happens that there are two kinds of benefits: those that arise from the reduction of ships' waiting time, reducing the transport unit cost of the *present* traffic; and those that come from the generation of additional traffic, creating thereby an added value, which is also a real benefit accruing to cargo owners from the port improvements.

206. Similarly, when port services, such as repackaging and storing, are provided directly for the cargo, they increase the cargo's value. That added value is also a real benefit arising from the corresponding port utilization.

207. The net benefit of the cargo owner will be dependent on the amount of the corresponding port charges on the cargo. In the long run, the ultimate benefits to the cargo owner resulting from port improvements concerning both ship and cargo will also depend on the extent to which ship operators pass on their net benefits. If they pass them on to cargo owners through a reduction of cargo transport costs, the ultimate benefit to the cargo owner will increase. Obviously, the ultimate benefit to the cargo owner is dependent on many factors including: real benefits, port-pricing policy and the behaviour of intermediaries.

208. There may be other indirect benefits which arise from port improvements and which extend to parties beyond the cargo owners. As an example, while the exporting cargo owner, as one of the users of the port, can be identified as the recipient of benefits from the trade opportunities opened up by the creation or improvement of a port, standing behind him are producers of the inputs of that export cargo, wage earners and their families, governments or other public authorities receiving tax, and so on. All the indirect benefits received by these persons and bodies are part of the benefits hitherto regarded as solely accruing to the cargo owner. Clearly, they cannot be tapped by the port authority in charging the cargo owner, since he does not benefit from them directly.

209. It is clearly quite difficult to identify and quantify the benefits of the cargo owner. Even when the value added to cargo from its transportation can be estimated, the part due to the port improvement often cannot be evaluated except in an arbitrary fashion. For example, the advantage gained from, say, opening up a hitherto undeveloped inland region of a country (see para. 205 above) arises from all the investments made, whether in roads, in the port, or in other forms of infrastructure. The attribution of the part of the total benefits arising from, say, each means of transport implies arbitrary decisions (e.g. to apportion benefits proportionately to investment costs).

C. The revenue flow

210. The flow of costs and the flow of benefits having been identified, the size of the flow of revenue needed must be determined. The flow of revenue depends on the level of the port charges, since revenue from port charges accounts, in most cases, for virtually all port income.

211. The appropriate level of any particular charge is, at least partly, a matter of policy. For example, if the policy is to provide a service, regardless of other considerations, then any level of charges acceptable to the traffic will do, including, at the limit, the "no charge" situation. This is, of course, an extreme example, but it does illustrate the fact that the determination of the appropriate level of any particular charge cannot be considered in isolation, but must be related to the pricing objectives and constraints of the charge or of the charging system – of which the charge is part. Objectives and constraints explain, in fact, the link between the flows of benefit, cost and revenue.

212. The relevant flow of revenue to be considered here, for pricing purposes, is quite different from the inflow of liquidity. The inflow of liquidity is made up, in addition to the revenue flow, of elements such as long-term loans, short-term bank credits and interest on bank deposits. The inflow and outflow of liquidity need to be kept in balance. Clearly, it is not possible to guarantee a balance between the inflow and outflow of liquidity in ports simply by the pricing system. However, whenever the outflow of liquidity exceeds the inflow, this gives rise to costs (interest on loans) and, therefore, has an incidence on the pricing system. Conversely, a gap between the liquidity flows in the other direction enables additional income to be earned.

213. The revenue flow examined here is that generated by port users as a counterpart to the benefit they derive from the utilization of the port. Such a flow ensures that the port is able to cover its own flow of costs. The revenue flow depends on the basic charge adopted and on the level of the corresponding traffic. As a result, any estimation of the future flow of revenue depends on the validity of the corresponding traffic forecasts. The same reasoning applies to the flow of port users' benefits, since the global amount of potential benefits resulting from a port improvement may be converted into real or physical annual flows in different ways according to traffic characteristics. This differentiates them from the flow of costs, which partly depend on traffic (variable costs) and partly do not (fixed costs). It will be shown in part two, by means of a hypothetical example, how the above question may be treated.

Part Two

ESTABLISHING PORT CHARGES

In part one the material necessary for the construction of a new system of port charges was examined. The aim of part two is to show, with appropriate examples, how the various port-pricing components, which up to now have been studied separately, may be combined in the establishment of actual port charges. It will be assumed that a revision of the port-pricing system in a hypothetical port has to be carried out. The necessary steps which have to be taken are described. Corresponding difficulties which may arise are analysed, and guidance is provided to assist in finding appropriate solutions. Although inspired by the situation in existing ports, all the examples given are hypothetical.

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Chapter VII

PRELIMINARY CONSIDERATIONS

214. Before the construction of a new port tariff is undertaken, some preliminary analysis is necessary in order to prepare the ground on which the future work will be based. In some ports, this preparatory analysis may require a great deal of effort and time, for example, it may involve the setting up of an adequate statistical and accounting system. No less important is the clarification of the desired objectives of the future port-pricing system. This chapter examines these and other necessary preparatory tasks.

A. The need for a good accounting and statistical system

215. A prerequisite for the construction of a new port tariff is the availability of reliable data. Most of the data should be provided by or derived from information regularly collected through the statistical and accounting systems of the port. The statistical system should provide basic data, such as the degree of utilization or employment of the port facilities, services, equipment and labour.[62] It should also provide data concerning port users, such as the turn-round times of ships in port, in order that benefits from new investments may be evaluated. The accounting system should provide most of the information necessary for an examination of the flow of port costs and revenues.

216. In many cases, however, data additional to those provided on a routine basis will be required, as will some additional processing of the basic data already available. Nevertheless, the better the accounting and statistical systems, the shorter will be the time required for carrying out the preparatory work.[63]

B. The clarification of port-pricing objectives and constraints

217. Before the construction of a new system commences, it is clearly important to take a decision regarding the pricing objectives and constraints. As this decision may present difficulties, the following comments give some practical guidelines. The main constraints and objectives will be examined in turn in the order in which they were discussed in chapter I.

218. It is seldom possible at the beginning of the preparatory work to define once and for all the different pricing objectives and constraints: some adjustment may be necessary when the first estimate of port charges is made. This justifies the postponement, in some cases, of the full examination of this subject to a later chapter, particularly chapter X, where examples are presented to illustrate the final steps in the calculation of port charges.

(1) *Cost constraints*

219. The cost constraints must be defined accurately since they play such an important role in pricing. It is desirable to start the examination of these constraints by calculating the flow of the total annual costs over the pricing period considered. In doing this, care should be taken to evaluate the actual costs, and not the amounts paid, which may not correspond with the real costs. Indeed, experience has shown that ports generally underestimate their costs (e.g. in under-evaluating capital charges, land costs, etc.). Any under-evaluation of costs may have serious repercussions, for it generally leads to undercharging users, a loss of revenue and, in the long run, a deficit.

220. The second step in defining the cost constraints is to separate those costs which accrue to the port entity from those which are borne by other bodies, such as the municipality, central government, or others. This implies studying the degree to which the port is self-supporting. According to the size of subsidies, the cost constraint can vary between two extremes. At one extreme is the situation where the port receives an open-ended subsidy which automatically covers any losses made in the port. In this case there is no cost constraint. (It has been shown in chapter II, paragraph 58, that this kind of subsidy is not generally conducive to efficiency.) At the other extreme, is the case where the port is completely self-supporting, all costs being covered by port charges.

221. In the foregoing paragraphs, the cost constraint was referred to in respect of the port as a whole. However, such a constraint may be determined also in respect of each cost centre separately. It will be shown in chapter X, how the cost constraint for the most important cost centres can be determined.

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[62] The UNCTAD secretariat has prepared a manual on this subject: *Port Statistics – Selection, collection and presentation of port information and statistics* (United Nations publication, Sales No. E.72.II.D.1).

[63] The importance of a good cost-accounting and statistical system in reviewing port pricing has been appreciated by the Comisión Centroamericana de autoridades portuarias (Central American Port Authorities Commission) which is at present studying, for all Central American ports, a common port-pricing structure, after having previously examined what should be an adequate cost-accounting and statistical system for the same ports.

222. It may be difficult for a port which has previously been subsidized to become suddenly self-supporting. Such a change implies an increase in port costs borne by the port and, as a result, a rise in the level of port charges, with all the corresponding implications. The following guidelines may facilitate such a transition.

223. There are two ways of increasing port charges: suddenly or progressively. After an important port improvement has been carried out, such as the provision of more berths, a major re-adjustment of all port charges may be appropriate. In other circumstances, changes in port charges will generally be more readily accepted by port users when they are progressive. As a result, it may take some years for a port to become really self-supporting.

(2) *Governmental constraints*

224. Before revision of the port-pricing system is undertaken, it is necessary to examine to what extent the port is free to determine its own charges. It could happen that if new port charges were not submitted to the controlling body, usually the Government, until after the project was completed, some rates might prove to be unacceptable, with the consequence that a complete recalculation of all port charges would have to be carried out. If the port entity is not independent, it should inquire from the superior entity what the pricing constraints are, so that these may be taken into account during the preparatory work. Such constraints may concern some users individually, for example, the application of particular rates for certain users, or they may concern the port as a whole.

(3) *Liquidity constraints*

225. The liquidity constraint means that, for the pricing period considered, the cash outflow should not exceed the cash inflow. It may be argued that there are two possible forms of liquidity gap in a port: a regular gap arising from a disequilibrium between inflows and outflows of cash for the operation of the port, or an exceptional gap arising from the financing of a port investment. In order to avoid a liquidity gap, some measures have to be taken which generally have an impact on costs and therefore on port prices.

226. Consideration will be given first to those liquidity gaps which arise at regular intervals in ports (e.g. each month or each quarter of the year, depending on dates of payments). Operational expenses such as wages have to be paid regularly, whereas it may happen that the corresponding revenue is obtained only with some delay. The solution to this problem is to associate "working capital" (sometimes estimated at one-twelfth of the annual operational expenses), when necessary, with port facilities or services. In this way, the lag in the cash flow gives rise to a cost, namely, the interest paid for borrowing the necessary "working capital".

227. An exceptional liquidity gap often arises from the financing of a port investment. It is out of the question for most of the ports to finance a major port extension, such as a new quay or breakwater, from accumulated reserves or profits built up from the charges collected from current users. Financing a major port investment implies, in most cases, obtaining loans, the funds being sometimes supplemented by internal reserves, since financial institutions are generally reluctant to finance the total cost of the investment. The interest on such additional loans would have to be added to the other port costs.

228. From the above remarks, it appears that the study of the liquidity constraint implies two successive approaches. First, before the price calculation starts it is necessary to study, during the pricing period, the elements which disturb the equilibrium of outflow and inflow of liquidities, such as investment plans, frequency of wage payments, etc. The costs involved in avoiding the liquidity gap have to be estimated. These costs will arise in addition to the other port costs. Then, when a first estimate of port charges is carried out, it will be necessary to check whether the liquidity constraint is fully satisfied over the pricing period. This task will be considered later.

(4) *The objectives of improving the utilization of assets*

229. A port has to decide what should be the desirable level of utilization for each of its assets. The decision, for the same kind of asset, may differ from port to port.

230. For instance, if two ports have different working regulations (e.g. one shift or two shifts per day) they will obviously have a different level of utilization of the same kind of assets, such as quay cranes, etc. Also, the economic utilization of transit sheds, for instance, depends on a variety of factors, including the arrival pattern of ships, the time cargo spends in transit, the storage method and the nature of goods.[64] In addition to the decision regarding the optimum utilization of assets, it has to be asked whether or not the level of the corresponding port charges will contribute to the improvement of the utilization of assets. The answer may differ from one asset to another and from one port to another. Practical guidelines on this subject will be provided in chapter IV.

(5) *The objective of establishing reserves*

231. Reserves are needed to cushion an organization against unexpected falls in revenue or rises in costs. These may occur in consequence of changing economic conditions, e.g. a general economic depression or inflation; unpredictable physical occurrences, e.g. damage or destruction of port assets; or of mistakes in management in the

[64] These subjects are discussed more fully in another report by the UNCTAD secretariat: *Berth throughput – Systematic methods for improving general cargo operations* (United Nations publication, Sales No. E.74.II.D.1).

planning phase.[65] In many ports it may also be desired to establish reserves as a source for the financing of the improvement or development of the port as an alternative to raising more money for these purposes from shareholders, if any, or by increased borrowing. As it is difficult to define properly the adequate level of the reserve, some additional comments are necessary.

232. The shipping industry is at present going through a period of rapid technological change. There is, therefore, a risk of making investment decisions which later prove uneconomic. The consequences of such decisions may be serious, since port investments are expensive and very often without alternative use. For instance, a port may decide to build a new container or roll-on/roll-off terminal on the strength of forecast traffic which fails to materialize. The adoption of a no-risk attitude, however, i.e. the postponement of investment decisions, could be equally mistaken since it would leave the port old-fashioned and obsolete. The port management needs, therefore, to make some reserves over and above the depreciation reserves based on the expected life span of its assets as an insurance against the risk of premature obsolescence, thus allowing sufficient flexibility for operating the port in a dynamic way.

233. Reserves are also desirable to offset the inroads of inflation. Some ports in countries where inflation is particularly high have adopted an *ad valorem* basis for calculating their charges (e.g. a given percentage of the c.i.f. cargo price). This method gives them a built-in protection from the effects of inflation on their operating costs and may be extended by an initial decision that a certain proportion of revenue each year is to be set aside as a reserve against the effects of inflation on the replacement costs of fixed assets. But such a measure would be very difficult to generalize for all charges in all ports. In annex IV, a method of calculating reserves which takes account of price increases is given.

234. Provided that a port is not governed by external regulations regarding the level of its reserves, the determination of the nature and level of the reserves is a policy matter for that port. The policy adopted should take account of the lessons learned from past experience, together with an evaluation of future expectations and issues involved in financing the port's expansion or improvement from internal resources rather than from new capital. Comparisons with other ports are not always relevant, as other ports may have different economic conditions, physical characteristics or traffic patterns. However, whatever the policy decision, it should be remembered that the cost of creating reserves has to be borne by present users, and there is a limit to what the users can bear.

235. Ports should not keep financial reserves in the form of idle cash balances. Whatever the aim of the reserves, good management will use financial reserves in the best way for the port on condition that the appropriate amount of liquidity will be available when necessary. This may be done by lending the money at interest in such a way that it can be recalled at short notice or, alternatively, by using the money to finance developments in the port which will yield an increased flow of income that will generate the needed liquidity. There can be no general rule as to the optimum use of reserves, since this will depend largely on the purpose for which they are constituted.

236. It is sometimes said that the creation of reserves encourages technical progress in a port in that money will be available for the purchase of modern equipment. Of course, new and up-to-date port equipment will generally be more productive than obsolete equipment and, although more expensive to buy, will be less costly to run in terms of cost per unit of output over the asset's life. It is not uncommon, however, to see in small ports two quay cranes being used together for the handling of a container which is beyond the weight capacity of a single crane. A specialized gantry crane would do the job better and faster; but whether or not to buy a gantry crane is not simply a question of having reserves, but of knowing whether such an investment will pay its way. If it is economic to buy a new crane, then the existence of reserves will help to make it possible to do so, particularly for a port which has difficulty in obtaining loans. But investing when the traffic does not justify such an outlay and buying only because reserves are available, would clearly be a mistake.

237. The surplus of current revenue over current costs, after contributions to those reserves which the port authority regards as desirable, represents the "profit" of the authority which is available, for example, for distribution to shareholders. Of the 43 port authorities in various countries which answered the second questionnaire of the UNCTAD secretariat,[66] however, none mentioned the earning of a profit as an objective. Of the 43 port authorities questioned by the UNCTAD secretariat, 8 indicated the rate of return which they tried to obtain on the capital invested. These rates of return fell in the range from 6 to 12 per cent.

238. A surplus, if any, must come from charges to present users. An objective to achieve a surplus should, therefore, be compatible with the other pricing objectives and constraints, particularly those relating to the utilization of assets. A large surplus may only be attainable by means of high charges, which might hinder a sound utilization of assets.

C. Other preparatory tasks

239. Before concluding such an examination of the port-pricing preparatory work, two last questions will be considered: the first refers to the choice of a pricing period,

[65] In this study, reserves are those financial provisions made for future events which, although probable, are not yet certain. As a result, provisions for depreciation, which correspond to a real cost, are not treated here.

[66] See annex II below.

the second to the evaluation of the cost of carrying out a revision of the port-pricing system.

240. A port tariff revision, although using mainly past data, should look to the future. Such an obvious statement has important consequences which should not be disregarded. In effect, because of inflation and the present rapid technical changes taking place in shipping and ports, it would be unrealistic to fix charges for too long a period ahead. Obviously, a tariff revision has to be established for a given period. Nevertheless, in choosing the period, a distinction should be drawn between the pricing structure (type of charge, basis of calculation) and the level of the prices. As a general principle, it is desirable to construct a pricing structure which will remain valid for a long period, say 10 years. As a consequence, the ideal pricing structure should take into consideration the expected changes in the port (traffic, investments, etc.) during that period.

241. Price levels, on the other hand, have to be calculated on different bases, since they will generally remain valid for a shorter period. This period depends on many factors, such as the rate of cost inflation and other increases in costs. In the absence of cost inflation, the rate of port charges could remain unchanged for five years or more, although with inflation as widespread as it is today, it may well be necessary to revise port charges at least once a year. There can be no fixed rules for deciding when to change the level of port charges. The point in time at which they are changed must be a compromise between the need to avoid excessively frequent changes, and the need for some flexibility in keeping charges at the level necessary to satisfy pricing constraints and objectives. An annual review of price levels, introducing marginal changes as required, may be appropriate in most situations.

242. It is equally important to select carefully the reference year for which the calculation of port charges will be carried out. If it were decided to construct a pricing system for a given period of time, say 10 years, it would be desirable to adopt a reference year to reflect conditions likely to prevail in that future period. As a consequence, all changes foreseeable in the port structure, traffic, costs, etc., would have to be considered. More often, however, a past year, preferably a recent one, is adopted as a reference period, past data being more reliable than future estimates. The construction of a pricing system entirely based on an expected rate of productivity, costs, traffic, etc., is more likely to lead to wrong results than if it is based on past experience modified by clearly visible trends. The method proposed in this report for the calculation of port charges will be based on past data corresponding to a particular reference year. Changes will be introduced, as necessary, to take into account expected future changes.[67]

243. The last point to be considered in connexion with the preparatory tasks for a port-tariff revision is the importance of evaluating properly the magnitude and the cost of the study. The magnitude, and therefore the cost, of a port-pricing study will depend on the size of the port, the quality of the accounting and statistical systems and data, the suitability of the old port-pricing structure and the availability of competent staff resources. Generally speaking, a port-pricing study is time-consuming and can take as much as two years to complete. In all cases, some data will have to be obtained by direct observation, which may require several months, particularly when traffic is seasonal. Because the last stages, i.e. discussing pricing proposals with superior bodies and implementing the new pricing system, may also require several months, it would be difficult, therefore, to carry out such a study in less than one year, particularly when both the pricing structure and the rates have to be studied for the port as a whole.

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[67] Instead of calculating port charges on the basis of data from recent years and then introducing changes to take into account expected variations in the pricing data (e.g. costs, traffic, etc.), it is also possible to use the pricing period as a whole, using discounting methods for the comparison of future annual costs and revenue. This is conceptually sound. However, this requires accurate forecasting. If, for instance, traffic forecasting is too optimistic, the result will generally be that present users will be undercharged and the port may have financial difficulties from the beginning, whereas a method based on data from recent years is likely to ensure better results in the beginning of the period, even if more frequent changes in the future are necessary.

Chapter VIII

THE COST/REVENUE CENTRE

244. As indicated in the preceding chapter, once the preparatory work has been done, the first step to be taken in calculating port charges is to determine port costs. In this respect, the various port services and facilities which give rise to port costs have to be classified in a way that will facilitate the future cost analysis. The so-called "cost-centre approach" will be used for this purpose.

A. Cost centres

245. A cost centre is an accounting device used for the grouping of port costs satisfying a given criterion. The aim of such a device is to facilitate a proper analysis of port costs. Such cost centres will provide a basis for building up the pricing structure: the various port charges will be based on one or several cost centres.

(1) *Definition of cost centres*

246. To avoid any misallocation of port costs, the definition of the cost centre has to be precise. There are four elements to be considered in defining a cost centre:

(a) *The service given*

247. Each cost centre correspond to one or several well-defined port services or facilities. As a rule, there will be a cost centre for each specific service or facility.

248. All general costs which escape the above classification can be grouped in two cost centres, one covering all general costs which occur on the maritime side, the other covering the remainder. Although the definition of each centre may appear satisfactory enough when the services included are described, it is equally useful to express precisely what services are not included. For instance, if there is a cost centre for cargo-handling services on board, it should be made clear whether or not the provision of quay cranes is included in the service given.

(b) *The place where the service is given*

249. Whether the location where the service is given covers the whole port area or only part of it needs to be specified. For example, the cargo-handling service on board may be limited to the transfer of cargo between the ship's hold and the quay apron.

(c) *The time dimension of port services*

250. Two different problems arise in connexion with the time dimension. The first one concerns the definition of the time during which the service is performed. After the expiry of this period, no further cost will enter into the centre. This point is particularly important for services like storage. The storage of goods may be divided into two separate services differing only in the time dimension, namely, transit storage and warehousing, the end of the transit-storage service being the starting time of the warehousing service.

251. The other problem related to the time dimension does not concern the cost centre itself, but the definition of the cost. Once a service is clearly allocated to a centre, a time unit has to be adopted for the cost calculation (e.g. hour, day, month, year). This problem will be examined later, when the cost calculation is presented.

(d) *The user of the service*

252. When port services and facilities are provided to specific port users, it is desirable to specify for each cost centre who these users are. There is generally no difficulty in doing this, with the exception of the services given at the point where sea and land meet, where certain services – cargo-handling on board, for instance – may be considered as being rendered either to the ship operator or to the cargo owner. In practice, the transportation contract defines who is responsible for such an operation; nevertheless, the answer may vary from one case to another.

(2) *Specific cost centres*

253. Two hypothetical examples of a specific definition of the cost centre are given in the following table (see top of page 46).

Table 8 indicates a possible distribution of various cost centres in a hypothetical post.

B. The choice of a pricing structure

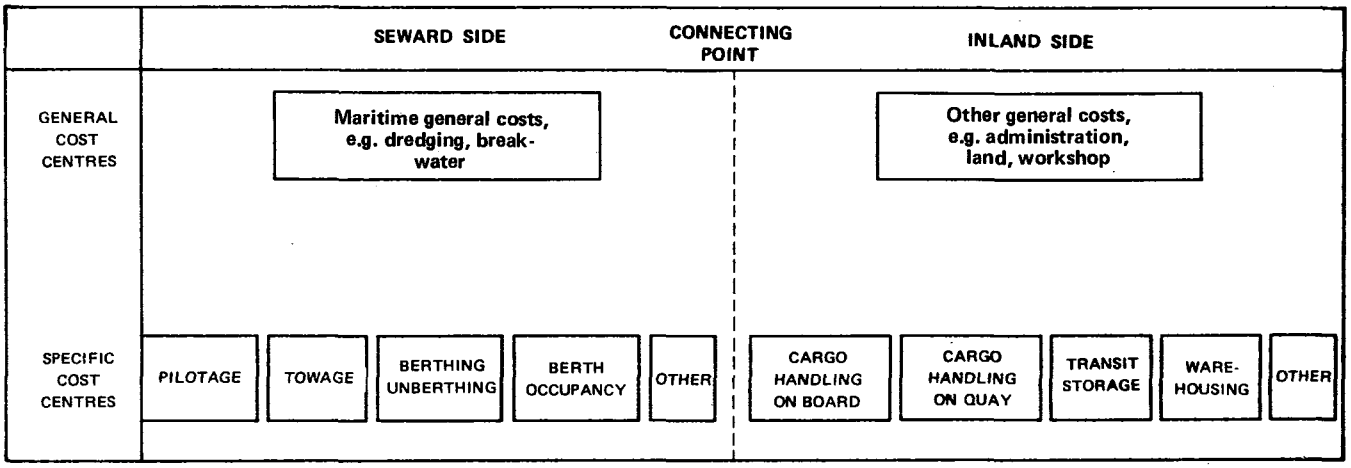
254. It would be a mistake to adopt the definition of the various port cost centres without taking into account what will be the future pricing structure, that is to say, what will be the future revenue centres. Revenue centres, like cost centres, are accounting devices. They allow the grouping of all revenue of the same nature. The definitions of cost and revenue centres should be related to each other in order to facilitate the comparison between revenue and cost. Such a link between revenue centre and cost centre

Specific cost centres	*Definition of centre*[a]				*Facilities or service*	
	Services performed	*Location*	*Time*	*User*	*Included*	*Excluded*
Cargo handling on board ship	Handling of cargo	From hold to quay	From the time the cargo is broken down in the hold until the sling is released on the quay	Ship or cargo	Tallying	Quay crane
Transit-shed storage	Temporary storage of cargo	Transit shed	From the time the cargo is deposited until cargo warehousing starts	Cargo	Surveillance Stacking	Tallying Warehousing Delivery

[a] Definition given for the unloading of cargo.

TABLE 8

Possible cost centres for a hypothetical port



implies the adoption of a comparable definition (e.g. each revenue centre must correspond to one or several cost centres) and the choice of comparable basic units for the revenue and cost calculation (e.g. if cargo-handling costs are calculated per cubic metre and then the corresponding port charges are established on a per ton basis, a comparison between revenue and cost will be difficult). This is why it is desirable before calculating costs, to adopt a pricing structure in harmony with the cost-centre definitions. In the adoption of the charging structure, there are two factors to be considered:

(1) *The number of port charges*

255. It may be decided to apply only one port charge (e.g. towage) in two or more cost centres (e.g. towage and berthing/unberthing). It may be equally decided that a given cost centre (e.g. aid to navigation) will be consolidated with the general cost centre. As a rule, each revenue centre must correspond to one or several cost centres (and not *vice versa*). In making the choice, it is necessary to take into account the administrative structure of the port, local or regional commercial practices and particularly, that pricing structure which is best calculated to achieve the pricing objectives within the constraints.

(2) *The definition of each charge*

256. The definition of each charge involves the adoption of a charging base (e.g. size of ship) and then a charging unit (e.g. grt). The main requirements of such a definition have already been presented in chapters III, IV and V. However, the desirability of adopting charging bases and units which may be utilized for both the revenue and the cost calculation should be stressed.

257. Before concluding such an examination, it is important to emphasize that the definitions of cost/revenue centres which are adopted should take into consideration future traffic requirements. For instance, as there is at present a trend towards shipping goods in unitized loads (containers, pallets, etc.), it would be a mistake to establish a pricing system which does not envisage a proper charge for such traffic, even though such traffic does not yet exist.

258. In table 9, a possible pricing structure which aims at meeting the above requirement is presented.

TABLE 9

A possible pricing system

Type of charge	*Nature of charge*	*Charging base*	*Basic units*	*Charging system*
A. *Charges on ship*				
1. Port dues on ship	Utilization of *general* maritime facilities and services	Two parts: *size* of ship and *type* of ship	*Gross* tonnage* (or grt or length)	Flat rates for different groups of *gross* tonnage* (or grt or length) and different *types* of ship (passenger, bulk carriers, etc. ...)
2. Pilotage	For piloting the ship	Size of ship	*Idem.*	Flat rates for different groups of *gross* tonnage* (or grt or length)
3. Towage	For towing the ship	*Idem.*	*Idem.*	*Idem.*
4. Berthing	For line handling during berthing/unberthing	*Idem.*	*Idem.*	*Idem.*
5. Berth occupancy	Occupation of berth by ship	Three part tariff. Size of ship. Nature of quay. Time at berth	*Gross* tonnage* (or grt or length) per day	Flat rates per day for different groups of *gross* tonnage* (or grt or length), and different types of berth (break bulk, ore, oil, etc.)
B. *Charges on cargo*				
6. Port dues on cargo	Utilization of the port (all general facilities and services)	Two parts: weight and nature of cargo	Metric ton	Flat rates per ton for different groups of products classified according to: *(a)* the nature of the cargo (ore, oil, general cargo, etc.) *(b)* what cargo can bear
7. Cargo handling on board	All operations for cargo from the ship's hold to the quay (and *vice versa*)	Two part tariff. Weight and presentation of cargo (bulk, bags, palletized, etc.)	Metric ton	Flat rates per ton for different groups of cargo classified according to cargo-handling method
8. Cargo handling on quay	All operations for cargo from quay to shed or delivery (and *vice versa*)	*Idem.*	*Idem.*	*Idem.*
9. Storage	Use of transit shed. Free period until ship is fully discharged	Three part tariff. Weight. Volume (or stacking condition). Time cargo spends in shed	Metric ton and day	Progressively increasing rates per ton per day for different groups of cargo having the same volume (or the same storing conditions)
10. Warehousing	Use of warehouses. No free period	*Idem.*	*Idem.*	Flat rate per ton per week for different groups of cargo having same storage characteristics

*As defined by IMCO.

Chapter IX

THE CALCULATION OF COSTS

259. This subject has been examined in chapter VI, and also in annex IV, where the various methods of calculating capital costs are discussed. The object of the present chapter is to illustrate, by means of an example, how costs are calculated. Specific and general costs will be examined in turn.

A. *Specific costs*

260. The calculation of specific costs will be illustrated for a single cost centre, namely, cargo-handling. A similar exercise has to be performed for all the other centres. Of all cost centres, the cargo-handling cost centre often gives rise to the greatest difficulties. It is also one of the most important in the port, because a large proportion of the cost and the revenue is generated there.

261. It is assumed that the corresponding tariffs are established on a per ton basis with different rates for groups of commodities having similar cargo-handling characteristics. As a result, specific costs will be calculated on the same basis. All costs which are not specific to cargo-handling activities, as for instance, those common to cargo-handling and storage services (e.g. the berth superintendent's salary) will be excluded from the cargo-handling centre and consolidated with the general costs of the port.

262. The first task is to classify all products in groups having the same or similar cargo-handling characteristics. For that purpose, cargo packaging has often greater importance than the nature of the cargo itself. For simplicity, cargo classification should be limited to no more than 10 or 15 cargo groups either discharged or loaded. For each group, a representative product is selected for the purpose of calculating costs (see table 10).

263. Once this classification has been carried out, the specific cost estimation can proceed. There may be either fixed or variable specific costs. In cases where such figures are not available from the statistical and the accounting systems, their evaluation may proceed as indicated in tables 10, 11 and 12.

264. First, several observations should be taken for each group of products in order to determine what are, in each case, the nature and degree of utilization of the cost components (capital and labour). Table 10 indicates the possible stages of each observation. Ship cycle, transfer cycle[68] and possibly storage should be examined separately. In each case, the cargo-handling process will be analysed. From these observations, the specific cost components, either fixed or variable, can be determined.

265. One additional word of explanation should be given concerning the distinction between fixed and variable costs, which may vary from port to port. Variable costs are those which are dependent on the volume of the traffic and hence are not already committed. For instance, in some ports, quay-crane drivers only drive their cranes: these are fixed costs. In other cases, quay-crane drivers may be employed for driving mobile cranes or tractors. As long as there is an alternative job for crane drivers elsewhere, other than driving quay cranes, they will generate variable costs in driving their quay cranes.

266. It will be noticed that variable costs and fixed costs have to be calculated on the basis of a given time unit: in the long run, all costs are variable. For the present exercise, it has been assumed that fixed costs, which are calculated on a one-year basis, do not vary over that period, and that variable costs which are calculated on a one-hour basis do not change over the hour.

267. Once the real or physical costs are known – both fixed and variable – they have to be expressed in monetary terms. Table 11 shows how such calculations can be made. It will be noted that the specific costs are computed *per ton*, which is the basic unit adopted for the cargo-handling tariff.

268. It should also be stressed that, for the calculation of the fixed cost per ton, some arbitrary allocation cannot be avoided, since fixed costs are annual costs independent of the volume of traffic. It is therefore desirable to keep the variable unit costs – which are in fact the real economic costs – separate from the fixed unit cost. The only purpose of the fixed unit cost is to contribute to the determination of a starting basis for the future calculation of the port charges.

269. It is important to note that the sum of the annual fixed costs, as obtained from table 12, may differ slightly from the total annual costs derived from the annual accounts. The reason is that the allocation of the annual fixed costs to the various groups of commodities is only

[68] For more details concerning the "ship cycle and transfer cycle", see the report by the UNCTAD secretariat, *"Berth throughput: Systematic Methods for improving general cargo operations" (op. cit.).*

TABLE 10

Cargo handling analysis

PORT:	COMMODITY CLASS: bag over 60 kg	UNLOADED OR LOADED: unloaded
YEAR:	REPRESENTATIVE COMMODITY: Sugar	ANNUAL VOLUME
		Of class: 100 000 tons
	PACKAGING: Jute bag	Of commodity: 20 000 tons

CARGO HANDLING METHODS

Slings are made up in the ship's hold (12 bags), transferred by the quay crane onto a trailer on the apron (2 slings per trailer). A tractor pulls the trailer to a storage area (transit shed).

SHIP CYCLES

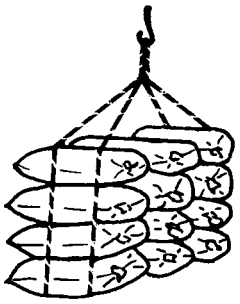
Average No. of cyles per hour: 20

Labour input		*Equipment input*	
Dockers:	12	Quay cranes:	1
Deckman:	1		
Foreman:	1*		
Driver:	1*		
Total	15		

Weight of bag: 100 kg

No. of bags per sling: 12

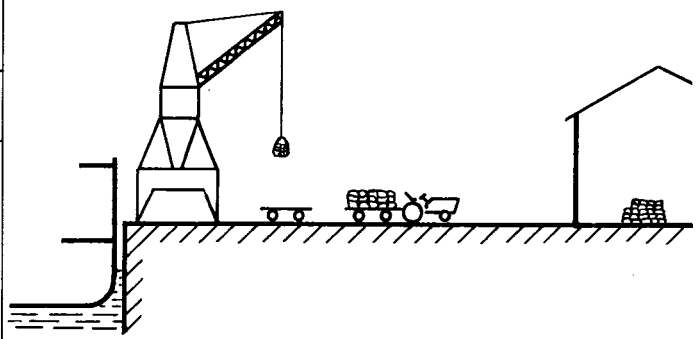
Weight of sling: 1200 kg



TRANSFER CYCLES

Average No. of cycles per hour: 10

Labour input		*Equipment input*	
Dockers:	16	Tractors:	1
Foreman:	1*	Trailers:	2
Driver:	1*	Forklift trucks:	0
Total	18		



PRODUCTIVITY

Average productivity (ton/gang/hour): 20 × 1.2 = 24
Average productivity (ton/man/hour): 24/(15+18) = 0.7

*Fixed cost.

NOTE. All the above figures are hypothetical and serve only to demonstrate how costs are calculated. In evaluating the number of cycles per hour, this should be the average number in the long run including periods of idle time.

approximate. A correction factor has therefore to be introduced for correcting any divergencies (e.g. if the ratio of calculated costs/total annual costs is, say, 1.04, all calculated fixed costs have to be reduced by 4 per cent). The above difficulty results from the fact that any allocation of fixed costs is arbitrary, since fixed costs are independent of the volume of traffic. However, it is desirable to reduce the degree of arbitrariness, so each cost component has been computed separately and the corresponding fixed costs have been allocated only to the traffic that makes use of them. For instance, some traffic does not use the quay crane and hence no part of the quay-crane fixed cost should be allocated to it. The simplest way of allocating fixed costs would be, of course, to compute them globally and to divide the total obtained by the global traffic expressed in tons. However, such a method would

TABLE 11

Calculation of the cargo-handling costs

First, all cargo-handling costs will be calculated on a per-hour basis, then they will be computed on a per-ton basis. (All the figures are hypothetical.)

A. LABOUR COSTS	*Costs per hour in dollars*
Variable costs:	
Dockers, deckmen: salary $1 per hour	1.00
Fixed costs:	
Dockers, deckmen	
Total annual fixed allowances plus employer charges: $300,000	
Total annual working hours: 1,000,000	
Fixed cost per hour:	0.33
Drivers (permanent)	
Annual salary and fixed allowances plus employer charges: $100,000	
Total annual driving hours: 50,000	
Driver cost per hour:	2.00
Foremen (permanent)	
Annual salary and fixed allowances plus employer charges: $120,000	
Total annual working hours: 40,000	
Foreman cost per hour.	3.00
B. CAPITAL COSTS	
1. *Quay crane*	
Period of life: 15 years	
Average annual working hours: 1,500	
Cost: $200,000	
Interest 8 per cent	
Variable costs:	
Electricity, maintenance and other use-related expenses: $5 per hour	5.00
Fixed costs:	
Annual insurance and other time-related expenses: $1,000 per year or per hour $0.67	
Capital costs[a] (interest and amortization) per hour: $15.58	
Total fixed costs	16.25
Total quay crane costs	21.25
2. *1 tractor and 2 trailers*	
Period of life: 5 years	
Average annual working hours: 2,000	
Cost: $10,000	
Interest: 8 per cent	
Variable costs:	
Diesel oil, tyres, maintenance and other use-related expenses . .	1.50
Fixed costs:	
Annual insurance and other time-related expenses: $500 per year or per hour $0.25	
Capital costs[a] (interest and amortization) per hour: $1.25	
Total fixed costs	1.50
Total tractor-trailer costs	3.00

C. CARGO-HANDLING COST

Table 10 gives all data concerning the cargo-handling of sugar in bags. The same example will be taken to illustrate how to calculate cargo-handling costs per ton.

TABLE 11 *(continued)*

Calculation of the cargo-handling costs

	Cargo-handling costs (dollars per hour)		
	Variable	*Fixed*	*Total*
Labour			
29 dockers and deckmen	29.00	9.57	38.57
2 drivers		4.00	4.00
2 foremen		6.00	6.00
Total	29.00	19.57	48.57
Capital			
1 quay crane	5.00	16.25	21.25
1 tractor, 2 trailers	1.50	1.50	3.00
Total	6.50	17.75	24.25
Total cargo-handling cost per hour	35.50	37.32	72.82

Cargo-handling cost of sugar in bags per ton

(Productivity: 24 tons/hour)

	Cost per ton in dollars		
	Variable	*Fixed*	*Total*
Labour	1.21	0.81	2.02
Capital	0.27	0.74	1.01
Total cargo-handling cost: per ton	1.48	1.55	3.03

Once all cargo-handling costs have been computed, for all groups of commodities, a general recapitulation for the port as a whole may be carried out, as illustrated in table 12.

[a] Amortization methods have been used for calculating annual capital costs. Then, the annual figures obtained have been divided by the annual working hours. Note that part of capital cost is use-related and hence is a variable cost (use-related depreciation). However, all capital costs have been considered as being fixed costs.

imply a greater degree of arbitrariness. It should be recalled that all the above calculations of unit fixed costs serve only to provide a basis for the price calculation.

B. General costs

270. For pricing purposes, this study considers as general costs all costs which are not specific (that is to say, all those not related to a specific service or facility priced separately). As a result, there may be both fixed and variable general costs. However, it will become apparent that in most cases general costs are fixed. It is also considered that there are no semi-fixed costs, that is to say costs which vary over a period between one hour and one year – the two periods chosen for the definition of variable and fixed costs.

271. Amongst general costs, all the administrative costs (administrative buildings, management, etc.) should be computed separately for cost control. Similarly, it is sound to isolate those costs which concern a given activity, such as workshop costs, aids-to-navigation costs, etc. The corresponding figures together with their variation over time will allow better management. However, for pricing purposes, all these costs will be aggregated.

272. The one-year period chosen for the calculation of the general fixed costs should be one during which conditions in the port were normal. All capital costs may be calculated in the manner indicated in annex V. Labour costs should be computed from the accounts. General variable costs, if any, may be estimated on a one-year basis and consolidated in each of the two general cost centres (maritime and other). It is not necessary to consider them separately, since there will not be a separate charge for each of them. General costs should not be allocated to each specific cost centre, since this arbitrary measure may be replaced, for pricing purposes, by other measures which will be described in the next chapter. Table 13 shows an indicative breakdown of the two general cost centres which may facilitate their calculation.

TABLE 12

Cargo-handling costs

Port: . . . . *Year:* . . . .

Commodity classes		*Traffic ton/year*	*Productivity ton/gang/hour*	*Unit costs (dollars per ton)*							*Annual costs (dollars)*		
				Variable			*Fixed*						
Code	*Definition*			*Labour*	*Capital*	*Total*	*Labour*	*Capital*	*Total*	*Total*	*Variable*	*Fixed*	*Total*
Cargo discharged													
a	Bag over 60 kg	100 000	24	1.21	0.27	1.48	0.81	0.74	1.55	3.03	148 000	155 000	303 000
b													
c													
d													
e													
f													
g													
h													
Cargo loaded													
a′													
b′													
c′													
d′													
e′													

TABLE 13

Breakdown of general[a] costs in a hypothetical port

Year:																						
Sub-classification		*Maritime*								*Inland*												
															Administration							
		Aids to navigation	*Dredging-hydrography*	*Other infrastructure works (e.g. breakwater)*	*Maritime equipment (e.g. boats)*	*Maritime workshop*	*Maritime administration*	*Miscellaneous services (e.g. fire fighting, police)*	*Others*	*Land*	*Equipment*	*Infrastructure (e.g. quays)*	*Superstructure (e.g. sheds)*	*Miscellaneous services (e.g. electricity)*	*Administrative buildings*	*Management*	*Accountancy*	*Personnel*	*Engineering*	*Exploitation*	*Others[b]*
Annual fixed costs	Labour																				
	Capital																				
	Total																				
Annual variable costs	Labour																				
	Capital																				
	Total																				
Total general costs	Labour																				
	Capital																				
	Total																				

[a] General implies here that the corresponding services or facilities are not priced separately.

[b] Depending on the port size, this may include a separate section for the remaining overheads such as: taxes, social charges, mail and telephone, insurance, rent, etc.

Chapter X

THE CALCULATION OF CHARGES

273. It is assumed that, at this stage of the pricing project, a pricing structure for each cost/revenue centre has been determined and flows of annual costs are known. In the present chapter, the remaining operations for calculating port charges will be examined in turn. They relate to:

(a) Utilization of assets;

(b) Income estimation per centre;

(c) First estimate of basic charges;

(d) Adjustment taking account of future trends.

274. The method proposed is made up of several iterations, for it is difficult to calculate once and for all a charge satisfying a number of criteria, some of which may be in conflict. The method, which is general in character, will be illustrated by reference to specific examples.

275. Port charges will be estimated first for a given year, which will be called "the reference year". In general, the reference year will be a recent one for which reliable data are available. The first estimate of port charges, based on past data, will have to be checked and tested and, if necessary, modified in the light of forecasts relating to the pricing period.

A. Utilization of assets

276. For each cost centre and the corresponding asset or group of assets, four questions should be asked systematically:

(i) What is the present level of the utilization of the asset?

(ii) What would be the desirable level of the utilization of the asset?

(iii) Can port charges contribute to the improvement of the utilization of the asset?

(iv) If the reply to the preceding question is in the affirmative, which type of port charge results in the desired improvement?

(1) *What is the present level of the utilization of the asset?*

277. For the centre considered and the period of reference, the utilization of the asset may be examined from two different points of view, that of the port authority and that of port users. As a result, there may be two different measures, both indicating the utilization of the same asset, as is illustrated below.

278. For the port authority, the interest is to find a measure of the asset's utilization which is supply-related or, in other words, which is physical or objective. A common way of measuring this utilization is to express the asset's utilization by the ratio of the quantity of units utilized to the total amount of units available during a given time period. For instance, berth occupancy may be measured by the ratio which the number of ship-hours at berth per month bears to the number of berth-hours available.[69]

279. The port user, on the other hand, is interested in a measure which is demand-related. Taking the same example as above, it does not really matter for a ship operator to know that there is a berth occupancy of, say, 80 or 50 per cent. What matters to him is the probability that his ship has to wait one or two days before berthing. If a port gives priority to certain classes of ships, then different users could have different measures for estimating the probability of having to wait for a berth, whereas the port authority's measure would remain constant.

(2) *What would be the desirable level of the utilization of the asset?*

280. This question raises the following considerations:

(a) How the asset is supplied (physical characteristics of the asset, costs of the asset for the port, port regulations, interdependence of the asset and the other port assets, etc.);

(b) How and by whom the asset is utilized (demand characteristics, such as working practices of users, sensitivity to price changes, users' benefits derived from the different levels of utilization).

281. To determine the optimum utilization of an asset involves studying in depth its utilization throughout its life. It is not the purpose of a pricing study to enter into such detail. In fact, what is required for pricing purposes is not a theoretical optimum level but an acceptable and practical one, first for the reference year and then for the following years of the pricing period. If such inputs are not available, an estimate must be used.

282. Obviously a good utilization of an asset may be either higher or lower than the actual one. "Good"

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[69] Examples are given in the UNCTAD secretariat's manual, *Port Statistics (Selection, collection and presentation of port information and statistics) (op. cit.).*

utilization rarely means full utilization, since this is likely to have harmful effects on the utilization of other assets and on the port users. For example, in the case of berths, a high berth occupancy (approaching 100 per cent) is only possible if long queues of ships waiting for berths are allowed to form. Equally, only an extremely low berth occupancy can guarantee that ships will never have to queue. Neither of these alternatives is acceptable. What is sought is a compromise between these two extremes.

(3) *Can port charges contribute to the improvement of the utilization of the asset?*

283. The answer to this question is related not to the supply but to the demand characteristics. In other words, the answer will depend on the extent to which the behaviour of port users is sensitive to variations in port charges. Price changes will only influence the behaviour of port users to the extent that: *(a)* the user has the power to change his behaviour (he may be constrained by other external factors); and *(b)* the price change is sufficiently significant.

284. As regards, first, the maritime assets such as dredged channels, protected waters, quays, many factors influence the behaviour of ship operators, of which port charges are only one, and certainly not so important as, for instance, the turn-round time of the ship and the quality of service. For this reason the improvement of the utilization of the maritime asset by ships may call for the use of more direct measures than variations in port charges.

285. As far as the inland facilities and services are concerned, there is a greater probability that the level of charges on cargo will influence the behaviour of cargo owners. The utilization of operational equipment or transit sheds may well be improved by applying penalty rates to discourage bad practices (e.g. fee for the use of a transit shed as a warehouse), or offering discounts to encourage more efficient ones (e.g. giving a discount for palletized commodities).

286. One factor which may militate against the use of charges as a means of improving the utilization of an asset is that charges are normally paid by agents. To the extent that agents are paid a fixed fee for their services or a fixed percentage of the total bill as a commission, reductions in charges may not necessarily lead to any modification of their behaviour. Similarly, any increase in port charges may be passed on to the ship operator or cargo owner without causing the agent to improve the port asset utilization. Clearly, therefore, incentives and disincentives must be publicized directly to the principals involved if they are to have maximum effect.

(4) *If the answer to the previous question is in the affirmative, which type of port charge results in the desired improvement?*

287. For each cost centre which has assets that are not correctly utilized and for which appropriate port charges may improve the utilization, two actions should be taken. The first is to adopt a pricing structure specially designed to improve the utilization of the assets in question. The other is to adopt an appropriate level for the unit charge.

288. As for the pricing structure, the example proposed in table 9 is intended to satisfy the general requirement of improving the utilization of assets. However, it may be necessary to refine these general indications in order really to improve the utilization of some assets. Taking the example of the quay cranes, which in some ports are under-utilized, a cargo-handling tariff which includes the provision of quay cranes may help to increase their utilization. In other cases where quay cranes may be in short supply and where the policy is to reserve the few cranes available for some specific activities, the separate pricing of quay cranes will help to achieve this objective. Another example of a pricing structure which may contribute to the improved utilization of assets is the pricing on a fixed-term basis for some users (cargo or ships) in order to promote a given traffic which is in the interest of the port or country (e.g. coastal traffic may be given a global monthly charge for the use of the port, whatever the number of calls).

289. As regards the choice of the level of the charge, it is necessary to make a distinction between the case of temporary under-utilization and permanent under-utilization. When a new asset is provided, it is usually under-utilized to begin with, then, as traffic builds up, the asset may become fully utilized, perhaps even becoming over-utilized before it is replaced or extended. In this case, the initial under-utilization is only temporary, and it is appropriate to charge a rate corresponding to the whole of the asset's life from the beginning. Such a policy leads to a measure of stability in the level of charges over the asset's life. The rate charged will normally be higher than the variable cost and will contribute to the fixed cost burden borne by the port.

290. If, however, traffic should show reluctance to use the asset because of the price charged and, as a result, the over-capacity should seem to become permanent, then it would be desirable to reduce the level of the charge in order to promote the use of the asset.

B. Income estimation

291. After the utilization of assets has been considered, the next task is to estimate the desired income from port charges for the chosen reference year. Annual income may be estimated at two levels: for the port entity as a whole and for each cost centre.

292. For the port as a whole, it is assumed that the financial objectives are already determined.[70] This knowledge, together with that of the total annual amount of costs

[70] See chap. I, VI and VII above.

accruing to the port, will make it possible to determine the desired *annual* revenue from port charges. This is a general target to the attainment of which each cost/revenue centre should contribute. The desired level of global income is a policy decision which must be taken at the highest port level and/or at governmental level.

293. Whatever the solution adopted for the port as a whole, a similar problem arises for each cost/revenue centre, namely, to define the desired global income of the centre. For this purpose, the following elements are already known:

(a) The flow of annual costs (fixed and variable);

(b) The pricing structure;

(c) The pricing requirements for improving the utilization of the assets.

However, this is not enough. In addition, it is necessary to know what the traffic of the centre can bear. In order to obtain an estimate of this figure, an inquiry has to be conducted amongst port users and a comparison with other ports (or with other substitutes, if any) carried out. From this information will result a first approximation of the desired income for the centre *(during the year considered).* Such an income estimate should be expressed in terms of the costs incurred in the centre. For instance, if there is a separate cost centre for a refrigerated warehouse, it may be desirable that revenue should cover the specific costs of the warehouse plus a given percentage of the general costs of the port.

294. Each port may have its own policy in defining what is the desired income level of the various cost centres. Furthermore, within the same port it may even occur that, although the global income for the port is relatively stable over the pricing period, in order to achieve some specific objective such as the improved utilization of assets, the various contributions of each cost/revenue centre may vary widely. As a result, definitive guidelines on this subject cannot be provided. However, the following steps and suggestions may be proposed when studying these matters. The approach assumes that the port authority supplies most of the port services and facilities. The objective is to define, for each centre, the desired annual level of the corresponding charge.

295. First, the specific cost centres should be studied, particularly those corresponding to complementary port services or facilities, that is to say, those which are not essential for a port. In normal circumstances, such centres should be self-supporting and even make a "reasonable" contribution to general costs and surplus. What "reasonable" means, varies from one port to another. Nevertheless, what is common to all ports, is that such complementary facilities and services should not be a burden for the port.

296. Then the other specific cost centres will be examined in turn. These may be subject to a user demand sensitive to price changes, and it may be desirable to keep revenues low and charges close to variable costs. However, this will be the situation only in some cost centres, and most of them should cover their costs and make a contribution to general costs and surplus. Here, the attention of port managers should be drawn to the fact that in many ports specific services, such as pilotage, towage, cargo handling on board, etc., are provided by self-supporting independent firms. If the traffic of these centres can make only a small permanent contribution to the general costs and surplus of the providing port authority, it is worth examining whether there is not an excess of costs in these cost centres.[71]

297. Although it is desirable that there should be self-supporting cost/revenue centres that make some contribution to general costs and surplus, some exceptional cases are unavoidable. These may be either temporary or permanent. The former case has already been examined. It results from the different degrees of utilization of an asset during its life. It is, in effect, quite normal that the volume of traffic is low to begin with and hence that it makes a low contribution towards general costs and surplus. It may even be necessary to impose a charge provisionally at a rate close to the variable cost in cases where a higher charge might deter traffic.

298. The other case, i.e. where a centre makes a permanent low contribution towards general costs and surplus, may arise (as already seen) from mistakes in planning decisions. However, it may also occur in the utilization of those particular assets, such as floating cranes, which although not frequently used, and hence permanently under-utilized, contribute to the services offered by the port and attract traffic. It sometimes even happens that such assets cannot be priced at the variable cost level, although they may be economically sound through the indirect benefits they generate. In this case, it is quite reasonable to fix the desired income level of these centres by considering only what the traffic can bear. All costs not covered by such income will be considered as general overheads of the port.

299. The above cases should be recognized, however, as being exceptional. There is a danger that temporary cross-subsidization or small contributions towards general costs might become permanent features. The temptation to extend to more and more cost centres the permanent low contributions to general costs and surplus should be resisted since, as has already been pointed out, revenue forgone in

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[71] In some ports the policy is to charge for the specific services at a rate close to their costs. In such cases, a practical way of evaluating the desired annual contribution from a specific centre to general costs and surplus is to assume that the corresponding service is provided by a separate firm. Then it is possible to estimate what would be the overheads of such a firm to be covered by the charges (e.g. x per cent of specific costs) independently of the port overheads. This method is particularly useful when the policy might be eventually to remove such a specific service from the port authority's responsibility. The above approach implies that any general cost or surplus of the port which is not covered by the contribution of all specific charges will be financed by the port dues (on ship and on cargo).

one centre may be difficult to recuperate elsewhere. Furthermore, port users, when they are undercharged, may get into the habit of using port assets uneconomically, and such bad practices are always difficult to eliminate.

300. Excessive cross-subsidization attributable to certain low contributions to general costs and surplus is open to objection also in the light of the effects of the introduction of technical progress in ports. If the port-traffic pattern were stable, permanent cross-subsidization of some cost/revenue centres by others might be admissible. In general, however, technical progress, although generating economic advantages, may lead to certain reductions in port revenue (e.g. improved cargo handling reduces a ship's turn-round time and therefore reduces also the revenue from any port charges on the ship calculated on a time basis). As a result, the former equilibrium between subsidized centres and subsidizing ones may collapse, and the whole pricing system may have to be reconsidered. A system which related charges closer to costs would have limited the magnitude of the necessary pricing changes.

301. Pursuing the examination of the desired annual revenue level for each cost centre, it is suggested that the berth-occupancy cost centre be studied after the other specific cost centres. As large capital costs, such as the construction of the quays, form part of the berth-cost centre, it could be argued that this facility exists not only for ships but also for cargo.

302. It may not, therefore, be possible to raise sufficient revenue from the berth-occupancy tariff on ships to cover all the quay costs. Hence in determining the desired annual revenue from this centre, the following elements have to be considered:

(a) Quay costs;

(b) The level of the charges which could contribute to improving the berth utilization;[72]

(c) The old tariff applied and tariffs applied for other ports;

(d) What the traffic can bear (this has to be considered in relation to the other port charges on ship),

(e) The amount of the annual contribution to general costs which has been estimated from the preceding calculations at the other specific cost/revenue centres.

That portion of the quay costs which cannot be recovered by revenue from berth-occupancy tariffs would be considered as overhead costs and consolidated with the general costs.

303. There still remains the examination of the desired revenue level of the two general-cost centres, i.e. that on the seaward and that on the landward side. The former includes all general costs on the maritime side and will be the object of the charge called "port dues on ship". Here, in general, the user demand is not very sensitive to port charges. However, ship operators have ways of reacting against excessive port charges (see chap. V and VI).

304. The general assets on the maritime side, such as breakwaters, etc. have large fixed costs, but practically no variable ones. Furthermore, as was mentioned above, cargo shares some of the advantages derived from the existence of the maritime assets. As a consequence, the desirable amount of income to be collected through port dues on ship should be calculated mainly by reference to what the traffic can bear, or in other terms, to the benefits for the ship operator when his ship visits the port. However, such an evaluation of the ship operator's benefits may be difficult to carry out, even if, at this stage of the project, only a global annual estimate is necessary. The following factors should be taken into account:

(a) The benefits accruing to different types of ship (liners and tramps, bulk carriers and break-bulk carriers, etc.);

(b) The need to consider separately the case of ships coming in for repairs, bunkering, etc.;

(c) The need to give appropriate consideration to those liners having selected the port as a terminal;

(d) The revenue already collected from ship operators (e.g. berth-occupancy tariffs);

(e) How other ports charge;

(f) Whether ships have the possibility of using another port.

305. These factors can be studied more easily when port dues on the ship have to be changed on a marginal basis. An example of such a marginal change is the case where the charges corresponding to new port improvements which directly benefit only certain ships (e.g. an increase in the depth of a dredged channel) have to be calculated.

306. After such a study of the desired annual income to be collected through port dues on ships, a portion of the general costs and surplus may still remain to be covered. It will be the role of port dues on cargo to provide the necessary additional revenue.

307. Once the annual level of income desired for each centre has been estimated, the next step is to calculate the basic level of each charge which generates such revenue for the year considered.

C. First estimate of basic charges

308. The level of the various basic port charges has to be obtained for each centre for the reference year, through several iterations. Although each centre has been considered globally up to now, it will be necessary to enter into much

[72] It could be argued that the real cost to the port authority of a ship occupying a berth, but not working, is the loss in net revenue which the port would expect to derive if the berth were occupied by a ship working normally. This figure can be derived from the cost and revenue estimates of the other cost/revenue centres.

more detail and consider each group of similar users, and each port asset separately.

309. A first approximation of the level of each charge is given by dividing the desired total income of each centre by the corresponding traffic during the reference year. This figure will have to be further refined in order to take into account the interdependent requirements of securing a good utilization of assets (each asset considered separately), of what the traffic can bear (each group of users being considered separately), and of the unit costs generated by each group of users (see table 11). It often happens that some requirements are in conflict: for instance, the income requirements may call for a high basic charge, although consideration of the utilization of assets and of what the traffic can bear may necessitate a lower one. Several possible solutions should be proposed, the final choice depending on the relative priorities adopted by the port management. In some cases, priority may be given to revenue, and the utilization of assets may suffer from such a choice, and *vice versa.*

310. It may happen that it is not possible to find a level of port charges for a given cost/revenue centre which satisfies all requirements. In such a case, it will be necessary to go back and revise the level of the global income which was required from that cost centre – and therefore also from other cost centres – as indicated in section B above. This procedure will have to be repeated until an acceptable level of port charges for each cost/revenue centre has been determined.

311. The foregoing discussion illustrates how elaborate may be the various calculations required in building up a pricing system. This is why some ports have found it effective to use a computer, which because it can carry out such iterations very quickly, permits the exploration of more possibilities and hence will lead to a more satisfactory pricing system.

D. Adjustment taking account of future trends

312. Once a first estimate of port charges has been established for the chosen reference year, it is necessary to consider, during the period adopted for the pricing study, how the system will work in the future. Because all the above calculations will have been based on past data, it becomes necessary to study how such data will vary in the future. Some data are external and independent of the price adopted, others are internal. Examples of external data are the evolution of the country's traffic, of shipping practices, of the infrastructure and organization of the port. Internal data are a function of the price level and may concern, for instance, the level of utilization of assets and the volume of that traffic which is sensitive to price changes. As a result of these changes the flows of traffic, costs and benefits will vary. It may happen that, although the pricing structure is still valid, some basic charges have to be changed to satisfy the pricing requirements for each year of the future pricing period. In order to introduce dynamics into the calculation of charges, the following steps are proposed:

(a) Using the first estimate of basic port charges, check for each year of the pricing period (5-10 years), how the flow of port costs will vary for the expected level of traffic and the port infrastructure and organization;

(b) Carry out the same exercise for the flow of port revenue;

(c) Examine, over the same period, how pricing constraints, particularly cost constraints, utilization of assets and liquidity balance, will be observed and objectives satisfied;

(d) For any year in which a serious mis-matching of cost and revenue becomes apparent which might hinder the achievement of pricing objectives within the limitations imposed by the constraints, reiterate all the above calculations of basic port charges as indicated in sections A, B and C of this chapter;

(e) Select as far as possible basic unit charges which satisfy both present and future requirements;

(f) If a single port charge does not prove satisfactory for the whole pricing period, estimate what marginal changes in such charges should be applied at given dates. For instance, if it appears that the present rates of pilotage cannot be satisfactory over the whole five-year pricing period adopted, it may be necessary to apply a 10 per cent increase after two years.

313. The introduction of dynamics into the calculation of charges involves the carrying out of a large number of calculations. Ultimately, the quality of the pricing system proposed will depend directly on how many iterations have been performed before the final set of port charges is adopted.

314. In the passages above in which the elements which may vary in the future were discussed, a reference was made to port traffic. Traffic forecasting is an important task to be performed for the purpose of producing a successful pricing study. While past trends in traffic evolution will naturally be helpful, they should not be the only basis for forecasting future traffic. Part of the port traffic may be influenced by price changes, and the pricing policy adopted may, therefore, induce some changes in the traffic. Furthermore, ports are links in the chain of transportation for a country's imports and exports. Accordingly, the volume and nature of the port traffic is dependent on the foreign trade and transport policy of the country concerned. This is why no traffic forecasting should be undertaken without taking into account the national foreign-trade policies and transportation plan and the expected growth and nature of the traffic of the port's main users.

Chapter XI

GUIDELINES FOR THE APPLICATION AND PRESENTATION OF THE NEW PORT CHARGES

315. Once the revision of charges has been completed, there remain some additional tasks to be carried in order to give effect to the new charges and present them to port users.

A. Application

316. Before the results of any pricing project are translated into action, it is most desirable to check the new pricing system by reference to actual data. One way of doing this is to apply the new pricing system in parallel with the old one (which at that stage is still the only one officially in force). Consequently, every day a double calculation of port charges is carried out. First, charges are calculated on the basis of the old pricing system and the figures so obtained are those which are presented to the port user. However, at the same time, the charges are also calculated on the basis of the new pricing system, and the new figures obtained may be compared with the previous ones. If at the end of such an experiment, which might last, say, for three months, no great divergences appear between the results obtained and those expected, the new pricing system may be adopted. Of course, not all results can be obtained from such an experimental period, for instance, those generated by the expected influence of the new charges on traffic flows. Nevertheless, such a trial run will disclose any serious mistakes which may have arisen in the revision of charges.

317. In order to facilitate the application of the new charges, it is eminently desirable to specify in detail how the port charges will be calculated and collected. In this respect it is necessary to define clearly the charging bases for ship and cargo, to specify which document will form the basis for the calculation of the charges (e.g. ship's manifest) and to indicate how many copies of such a document are required and by whom.

B. Presentation of port charges

318. Two different problems arise here. First, how should port charges be presented to the management or the controlling government? Secondly, how should port charges be presented to port users?

(1) *Presentation of port charges to superior bodies*

319. As has been mentioned earlier in this report, port charges have generally to be approved by the government. Similarly, if the port is under the jurisdiction of a municipality, it will seldom have freedom to modify charges without referring to the controlling body. This is why the presentation should draw particular attention to the main changes which will ensue from the new pricing system. Accordingly, it is desirable to make comparisons between the pricing system proposed and the old one, particularly as far as the following items are concerned:

(a) Global income;

(b) Basic income from the most important user groups;

(c) Any relevant element, such as the level of utilization of assets.

In addition, it is desirable:

(e) To make reference to any national or local regulation related to port pricing policy;

(f) To make reference to and comparisons with other ports, particularly similar or competitive ones;

(g) To present financial indicators showing the basic relationship between expected revenue and costs.

320. Of course, particulars have to be given for the reference year, for past and future years. Generally speaking, such a presentation should be as brief as possible, any detailed explanations being set out in annexes.

(2) *Presentation of port charges to port users*

321. In order to be able to give some guidance regarding the presentation of port charges to users, the secretariat analysed some 50 schedules of port charges. The presentations varied greatly from one port to another. Each port has its own customs, and a particular presentation adopted by one may not be acceptable to another.

322. Because of this situation any idea of achieving a systematic standardization of port-tariff schedules has been dropped for the time being. Nevertheless, whatever the policy of a particular port, some guidelines aimed at improving the presentation and facilitating the understanding and use of such schedules can be given. The suggestions below, which do not claim to be exhaustive, have been classified under four headings: content, terminology, presentation, distribution of tariff booklets.

(a) *Content*

323. The satisfactory use of the schedule demands that the subject matter be clearly classified. One order of presentation which recurs frequently in the schedules

studied and which has the merit of being clear is the following:

Chapter I – Charges on the ship
Chapter II – Charges on the cargo
Chapter III – Other charges.

324. These different chapters are generally prefaced by an introducing explaining certain provisions of a general nature. Some ports add other chapters to this list, in the light of their specific needs.

325. Of the general provisions which are accordingly usually found at the beginning of the schedule, the following are of general interest:

(i) Copies of official texts establishing port charges or indicating their source;
(ii) Table of contents, complete with alphabetical index;
(iii) Explanation, in a special list, of the meaning of all the abbreviations used;
(iv) List of amendments to the original text of any other system of making sure that the tariffs are up-to-date;
(v) Normal working hours and overtime which may possibly give rise to an increase in charges (holidays should be indicated);
(vi) The address of the authority from which the tariff schedule may be obtained, together with its selling price (if any).

326. Some of these particulars may already appear in the information brochure or annual report which some ports publish separately. Also, port charges are often reproduced or summarized in these information brochures. Some port authorities include in their tariff schedules the other main duties and charges of the other port entities, such as those for the services performed and the charges quoted by a separate cargo-handling company.

327. Turning now to the various chapters dealing with charges, it is useful in each case:

(i) To give a precise definition of terms which are liable to cause difficulties or are open to misinterpretation. For example, the tonnage type of the vessel, i.e. whether net, or gross; the units of weight, length, area, volume, time and currency used; the precise characteristics of periods during which goods are exempt from storage charges, etc;
(ii) To specify who is liable for the charge (ship's agent, cargo owner, etc.); where payment is to be made, which documents must be submitted, and the number of copies required.

328. It is essential to specify clearly, for each tariff, the nature and extent of the port service to which it relates, explaining in detail anything which may give rise to misunderstanding. For example, the stevedoring tariff sometimes covers such services as opening of the hatches, breaking out, slinging, cargo handling as far as the quay, and the supply of slings, while other related services, such as the use of quay cranes or the cleaning of holds, are occasionally billed separately. Having explained the tariff rate(s), it is useful to note, where appropriate:

(i) Any rebate accorded;
(ii) Any exceptions to the general rule;
(iii) Any penalties for false declarations.

329. Some ports provide with each tariff a detailed description of the rights and obligations of each of the parties concerned. Other authorities prefer to publish this information in a separate publication dealing with port regulations in general; or else such information is set out in a special chapter so as not to interfere with the presentation of the charges.

(b) *Terminology*

330. A study of the tariff schedules available and of the general recommendations made on this subject by specialized national bodies reveals considerable differences in the terminology used. Different names may be found for port dues on the ship and on the cargo. However, it would be difficult to standardize the names to be given to each charge, as any attempt to do so would involve the standardization of the very nature of these charges. Moreover, the terms themselves are firmly anchored in local customs.

331. Consequently, it may be desirable to adopt internationally a common basis for *classifying* port charges. The different local names may be found in each class, but the adoption of a common international basis of classification will make it easier for the user to grasp their meaning and scope. Such an experiment calls for the adoption of clear and simple rules and terms which are easily translated into the principal languages.[73] The following main terms are intended as a starting point for an international standardization of the terminology relating to port charges.

332. First, a distinction should be made between *port dues* and *specific port tariffs.* The port due *(droit de port, derecho portuario)* is levied for the use of the port, without any service being specified. It is subdivided into port due on the ship and port due on the cargo. The port due on the cargo may be charged either to the representative of the cargo or, in some cases, to the representative of the ship. Accordingly, this general term corresponds to the following terms used locally:

Port due on the cargo: tonnage due, wharfage charge, toll, commercial tax, due on goods, tax on goods, port rates, etc.

Port due on the ship: harbour due, port-utilization due, conservancy rates, wharf due, harbour rent, tonnage due, anchorage, etc.

333. For all the other port tariffs charged in respect of specific services or for the use of a clearly identified part of the port, it is proposed that the term: *specific port tariff*

[73] For a list of the main terms used in this study, see page vi above (Terminology).

(tarif portuaire spécifique, tarifa portuaria específica) should be used. This general term will apply to such varied tariffs as: berth occupancy; berthing/unberthing; pilotage; towage; stevedoring; cargo-handling on quay; storage; warehousing; rent of equipment, etc.

334. It is equally useful to distinguish transit storage tariffs from warehousing tariffs. The former concern the storage of goods in transit sheds or open areas for the short period normally necessary for the carrying out of efficient port operations (loading/unloading; clearance, receipt/delivery). The latter concern the storage in warehouses or other areas where these goods, for various reasons, need to remain in the port for longer than the transit storage period. In some cases, it may happen that the place in which goods are stored is the same for both transit storage and warehouse (e.g. heavy goods staying in an open area).

(c) *Presentation*

335. There are certain advantages, in particular those of clarity and conciseness, in presenting port-tariff schedules in tabular form. For purely illustrative purposes, and without necessarily corresponding to views expressed earlier in this report, table 14 reproduces the form used by one port which is an example of a tabulated presentation that is comprehensive, clear and well-designed. Because of the size of certain tables, however, such schedules usually need a fairly large format.

336. Tariffs presented in non-tabular form may permit longer explanations and, since they can be fitted into smaller formats, are somewhat easier to distribute and carry, but this advantage is gained at the expense of clarity. It is worth the effort to set out clearly the tariff rates and the titles of the various charges, for example, by the use of capital letters, titles in the margin, etc. The schedules may be placed in a ring binder, bound or simply presented in separate sheets. The first system is well suited to the tabulated system, permits the insertion of successive amendments and avoids reprinting or addenda which are easily mislaid.

337. Below are some practical suggestions made as the result of studying a number of pricing schedules:

(i) The allocation of a reference number to the various charges simplifies their application;
(ii) The use of thumb indexes for bulky schedules facilitates their consultation;
(iii) For the benefit of countries whose national language is not used in the shipping world, it is desirable to publish port charges in two languages. One way of doing this is to print the recto of each page in the national language and the verso in the international language adopted;
(iv) In order to check that all the amendments published have actually been put into effect, a simple method is to prepare in advance a list of the algebraic symbols of future amendments. As and when these amendments are published, the corresponding symbol on the list should be ticked off and, where appropriate, the date of entry into force indicated.

(d) *Distribution*

338. The distribution of schedules of port charges enables users to evaluate the costs they will incur at the port they propose to visit, to make their choice of services required and to establish their own budgets. The publication of schedules also indicates on the part of port authorities vis-à-vis foreign users that the latter will not be subject to discriminatory measures but will be accorded the same treatment as other port users. Moreover, the port authorities themselves have a great interest in having access to the tariff publications of other ports, particularly of those in the same geographical region as their own. Only by facilitating the distribution of its own port charges will a port obtain reciprocal treatment from neighbouring ports.

339. In order that such distribution may be easy, the tariff systems in force must be as simple as possible, since tariff systems which are too complex involve issuing extremely voluminous tariff schedules which are difficult both to distribute and to consult.

340. Port tariff schedules contribute to a port's reputation. In most cases they will be circulated in foreign countries, and it may well be that a future user's first contact with the port will be his reading of the tariff booklet. Consequently, it is desirable that it should be carefully planned and presented. Such schedules will play a role in facilitating world trade.

TABLE 14

Model for the presentation of port charges (tabular form)

Board of Harbor Commissioners -- Port of Los Angeles – Tariff No. 3	Sixth Revised Page 14 Cancels Fifth Revised Page 14

Section Three — *Item No.*

Dockage

DEFINITION

Dockage is the charge, calculated in accordance with the dockage rates named in this Tariff, assessed against a vessel for berthing at or making fast to a municipal wharf, pier, bulkhead structure, or bank (inside berth), or for mooring to another vessel so berthed (outside berth). 300

BASIS FOR COMPUTING DOCKAGE CHARGES

The rates for dockage shall apply according to the over-all length of the vessel, except as otherwise specifically provided in this Tariff. United States Custom House, Lloyd's Register, or American Bureau of Shipping measurements, when available, will be used in determining the size of vessels, but the Board reserves the right to measure vessels when necessary to obtain measurements for use as the basis for its charges. 305*

FREE DOCKAGE

Free dockage will be accorded vessels: 310

(a) Engaged exclusively within the limits of Los Angeles Harbor and Long Beach Harbor while occupying an outside berth and discharging into or loading from the vessel to which it is made fast;

(b) Using a public landing when conforming to the provisions of Item 820 of Section Eight hereof;

(c) Defined as commercial fishing vessels when conforming to the provisions of Item 905 of Section Nine hereof;

(d) When, in the discretion of the Board or the General Manager, conditions may warrant the temporary suspension of regular dockage charges against combat or training vessels, including vessels auxiliary thereto, of the United States of America or any other nation;

(e) Under 20 tons gross register, except commercial fishing vessels when the rates provided in Section Nine shall apply;

(f) While actively engaged as a tug boat when made fast to another vessel which is being charged dockage;

(g) Using a wharf or landing at a small boat marine oil service station while taking on petroleum or products or compounds thereof.

DOCKAGE TO BE PAID BY VESSELS

Dockage, at the rates named in this Tariff, shall be assessed against all vessels subject to the payment of dockage under these rules, and shall be paid by the vessel so assessed, through its master, owner, agent or other person duly authorized so to do, before any such vessel leaves the Port of Los Angeles, unless such vessel is on the Credit List, in which event the master, owner, agent or other person in charge of such vessel shall file with the General Manager, within ten (10) days after such dockage shall accrue, such information respecting the docking and movement of any such vessel, on blanks furnished by the Port, as said Port may require. (See Item No. 1215, Credit List; Item No. 1220, Unlawful to Fail or Refuse to Pay Tariff Charges; and 311

TABLE 14 *(cont.)*

Model for the presentation of port charges (tabular form)

Board of Harbor Commissioners – Port of Los Angeles – Tariff No. 3	Sixth Revised Page 14 Cancels Fifth Revised Page 14

Section Three (cont.)

Item No. 1225 (particularly paragraph (g) thereof), Payment of Charges and Fees, and Enforcement Thereof.)

Order No. 3814, Adopted January 15, 1969. Effective May 5, 1969
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Issued by BOARD OF HARBOR COMMISSIONERS
K. R. SADLER, Traffic Manager
1412 Occidental Center, Los Angeles, California 90015

Correction No. 183

*Change.

ANNEXES

ANNEX I

FIRST UNCTAD SECRETARIAT QUESTIONNAIRE

Answer sheet

Port: . . . . . .

Country: . . . . . .

Date: . . . . . .

Operation or service	*Give name of body responsible for it*	*State whether publicly or privately owned*	*If public, indicate whether it is self-governing or part of a larger authority. If the latter, give name of the larger authority*
Navigational aids			
Pilotage outside port . . .			
Approach to port			
Locks			
Port pilotage			
Towage			
Boatage			
Berthing			
Departure from berth . . .			
Breaking out			
Stowing			
Cargo handling on board . .			
Transfer to lighters			
Unloading/loading of lighters .			
Cargo handling on quay . .			
Transport to/from storage . .			
Storage			
Delivery to/receiving from means of inland transport .			
Other services to ships			
Surveillance			
Supplies			
Special services (medical, etc.)			
Repairs			
Marine policy			
Fire fighting			
Others (specify)			
. . . . .			
. . . . .			
Other services to cargo			
Surveillance			
Tallying			
Marking			
Weighing			
Sanitary measures			
Others (specify)			
. . . . .			
. . . . .			

ANNEX II

SECOND UNCTAD SECRETARIAT QUESTIONNAIRE

Port: . . . . . .

Country: . . . . . .

Date: . . . . . .

QUESTIONNAIRE

Question 1. What are the financial objectives of the port?

Please put a tick in the appropriate box.

☐ to cover current operating (including taxes, if any) and maintenance expenses only;

☐ to cover current operating (including taxes, if any) and maintenance expenses and depreciation;

☐ to cover current operating (including taxes, if any) and maintenance expenses, depreciation and interest charges on loans;

☐ to cover current operating (including taxes, if any) and maintenance expenses, depreciation, interest charges on loans and to make provisions for port improvement;

☐ to cover current operating (including taxes, if any) and maintenance expenses, depreciation and to earn a rate of return on the capital employed. In this case, please state the target rate of return:

_____

☐ other (specify) _____

_____

_____

Question 2. Who bears the cost of the following new investments? If the cost is not borne fully by the port administration, what is the proportion of the cost borne by it and by others?

New investment	*Proportion of the cost borne by*			
	Port administration	*The State*	*The municipality*	*Others**
Aids to navigation . .				
Infrastructure				
Approach channel (dredging).				
Breakwaters				
Land				
Quays				
Superstructure				
Warehouses.				
Buildings				
Handling equipment . .				

*Please specify: _____

_____

Question 3. Are the following assets subject to depreciation and, if so, on what basis?

	Is the asset subject to depreciation?		*Basis of depreciation (Please complete this section only if the asset is subject to depreciation)*						
			Please write yes in the applicable column			*Period of depreciation (no. of yrs.)*	*Please write yes in the applicable column**		*If compounded please give the rate of interest used*
	Yes	*No*	*Historic or original cost*	*Present replacement cost*	*Future replacement cost*		*Straight line method*	*Compounded (sinking fund) method*	
Aids to navigation . .									
Dredging									
Breakwaters									
Locks									
Concrete quays . . .									
Steel quays.									
Wood quays									
Land									
Filling of land									
Surfacing									
Floating equipment . .									
Quay cranes									
Gantry cranes									
Mobile cranes									
Trailers									
Tractors									
Fork-lift trucks . . .									
Buildings									
Warehouses.									
Installations (for telephones, water and electricity supplies) . .									
Other fixed assets (please specify) . . .									
Other mobile equipment (please specify) . . .									

*If neither method is used, please give a brief description of the method used: _____

Question 4. What was the operating revenue received by the port administration for each of the following items during any recent financial year ? Alternatively, what proportion of the total operating revenue received by the port administration during any recent financial year was accounted for by each of the following items?

Financial year: . . . . . .

	Operating revenue in local currency	*Percentage*
Port dues: levied on ships		
Port dues: levied on cargoes:		
(a) charged to shipowners or their agents .		
(b) charged to cargo-owners or their agents		
Pilotage		
Towage		
Cargo handling		
Rent of handling equipment		
Warehousing and storage		
Sundry services and facilities		
Other revenue		
TOTAL		

ANNEX III

Contribution of the various port charges to the revenue of 36 port authorities

Main port charges	*Percentage of contribution in each port examined*																																			
	Ports where port authority carries out cargo handling (15 ports)															*Ports where port authority does not carry out cargo handling (21 ports)*																					
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*
General port dues (on ship/cargo) .	44	5	12	17	52	50	24	49	9	64	57	49	63	16	31	47	38	51	45	54	85	69	44	56	56	68	38	61	20	79	57	81	56	63	42	55
Pilotage	x	5	3	x	1	1	2	x	1	x	x	x	x	2	x	x	x	6	5	4	5	x	x	6	8	x	x	1	x	x	x	8	1	2	8	x
Towage	2	4	6	4	1	–	3	x	10	2	4	x	x	5	x	28	x	x	10	x	x	x	2	10	x	x	14	x	x	x	x	4	x	4	16	x
Cargo handling	17	50	51	37	34	39	51	18	31	19	25	37	17	39	58	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rent of handling equipment . . .	2	0	3	10	x	1	x	11	8	8	5	2	1	1	x	5	x	x	3	18	1	13	2	2	1	6	15	9	37	x	x	x	12	23	x	12
Warehousing and storage	24	24	8	14	11	4	5	14	14	5	4	x	11	36	6	x	27	10	25	4	1	1	38	21	27	20	21	16	6	11	3	x	2	6	x	15
Sundry services and facilities . . .	1	4	4	9	1	x	10	4	14	1	2	x	x	1	2	3	4	5	8	7	2	3	3	0	5	2	1	x	x	3	5	6	9	1	x	8
Others revenue	10	8	13	9	x	5	5	4	13	1	3	12	8	x	3	17	31	28	4	13	6	14	11	5	3	4	10	12	37	7	5	1	20	1	34	10
TOTAL	100 ◄																																			► 100

Source: Compiled by the UNCTAD secretariat.

NOTE. An "x" indicated in the above columns means that services are not provided.

ANNEX IV

LEVEL OF THE MAJOR PORT CHARGES ON SHIPS

The following four tables are the result of a statistical analysis by the UNCTAD secretariat of data in the periodical bulletin of BIMCO for the period 1966-1970

Each case corresponds to data collected from a disbursement account of a ship in a port. Disbursement accounts of 188 ships from 83 countries were examined.

TABLE A

Frequency table of level of port dues on ship

	Port dues per day (dollars per n.r.t.)						
Ship size n.r.t.	*Up to and including 0.09*	*0.10-0.19*	*0.20-0.29*	*0.30-0.39*	*0.40-0.49*	*0.50 and over*	*Total no. of cases*
0 - 999	26	15	4	2	3	–	50
1000 - 4999	43	10	1	3	1	2	60
5000 - 9999	36	5	2	2	–	2	47
10000 and over	16	5	2	1	1	1	26

TABLE B

Frequency table of level of pilotage charges

	Pilotage (dollars per n.r.t.)						
Ship size n.r.t.	*Up to and including 0.09*	*0.10-0.19*	*0.20-0.29*	*0.30-0.39*	*0.40-0.49*	*0.50 and over*	*Total no. of cases*
0 - 999	15	13	9	3	2	2	44
1000 - 4999	32	15	3	1	1	–	52
5000 - 9999	37	4	–	–	–	–	41
10000 and over	19	3	–	–	–	–	22

TABLE C

Frequency table of level of towage charges

	Towage (dollars per n.r.t.)						
Ship size n.r.t.	*Up to and including 0.09*	*0.10-0.19*	*0.20-0.29*	*0.30-0.39*	*0.40-0.49*	*0.50 and over*	*Total no. of cases*
0 - 999	5	7	1	3	–	–	16
1000 - 4999	24	7	4	2	–	–	37
5000 - 9999	21	12	–	–	–	–	33
10000 and over	20	6	2	–	–	–	28

TABLE D

Frequency table of level of charges (berthing – unberthing)

Ship size n.r.t.	*Boatage (dollars per n.r.t.)*						
	Up to and including 0.09	*0.10-0.19*	*0.20-0.29*	*0.30-0.39*	*0.40-0.49*	*0.50 and over*	*Total no. of cases*
0 - 999	19	2	1	–	–	1	23
1000 - 4999	22	1	–	–	–	–	23
5000 - 9999	19	–	–	–	–	–	19
10000 and over	13	–	–	–	–	–	13

ANNEX V

THE TREATMENT OF CAPITAL

1. Several methods are currently used for calculating capital charges. The most widely used are presented and analysed below and some problems particular to their utilization in the pricing field are studied.

A. Basic methods for calculating capital charges

(1) *Preliminary considerations*

2. The various methods for converting capital expenditure into a flow of annual capital costs may be classified in two groups. The first group will be given the heading "Depreciation methods", the second "Amortization methods".

3. Before presenting these methods and examining their respective advantages and disadvantages for pricing purposes, it is necessary to be clear that any sound method for calculating capital charges must satisfy the following condition. For a given asset, the sum of the discounted values of the annual capital charges (interest and depreciation or amortization) incurred during the period taken into consideration (normally, the expected economic life of the asset) has to be equal to the initial capital expenditure.

(2) *Depreciation methods*

4. All these methods are based on an estimation of the annual depreciation of the asset (the asset loss in value for a given year). They all diverge by giving different figures for the same asset, in such an estimation. In some cases, annual depreciation is constant (straight-line method),[a] in other cases, annual depreciation decreases over the period of life of the asset. In all cases, however, the total of all the annual depreciation charges equals the initial cost of the asset.

5. Once the asset depreciation is known, all these methods converge. An estimation of the asset's net value is made (initial capital cost minus the accumulated annual depreciation). Then an interest is applied to the net value of the asset. Such an interest is a real cost, since it corresponds to what might have been earned on the capital if it had been invested otherwise.[b]

6. Among the various possible depreciation methods, an illustration of the so-called straight-line method may be given as follows.

7. Notationally, if the original cost is C, the rate of interest is r, and the period of the expected economic life of the asset is n years and assuming that the asset has no scrap value, then the annual depreciation charge is a constant amount $\frac{C}{n}$. The annual interest charge is rC for the first year, $r(C-\frac{C}{n})$ in the second year, and so on. The sum of the annual interest and depreciation charge gives the annual capital charge. Since the interest charge becomes less each year, the total annual capital charge diminishes accordingly from one year to the next. If $C = 1{,}000$, $r = 0.05$, and $n = 10$, the annual capital charges are as shown in table A.

8. It will be noticed that such a method satisfies the requirement of paragraph 3 above.

9. The main advantage of the straight-line method is its simplicity. Furthermore, such a method is widely applied in accounts because it satisfies the fiscal regulations of many countries. Finally, the straight-line method and the other "depreciation methods" are the only ones allowing for a separate estimation of the net value of the asset.

10. The main disadvantage of the straight-line method and of most of the other depreciation methods when used for pricing purposes is that it gives figures that vary yearly, a fact which makes the pricing exercise more difficult. Furthermore, the annual capital charges have to be calculated year by year over the economic life of the asset and lastly, the estimate made of the depreciation is often far from reflecting the real loss in value of the asset.

11. Nevertheless, it seems that for some kinds of small equipment or existing assets the simplicity of the method more than compensates for the drawbacks. In order to avoid repetitive annual calculations, an average figure may also be taken (for instance, the capital charges corresponding to the year 5 in the above numerical example).

(3) *Amortization method*

12. The only method relevant here is the so-called "sinking-fund" or "annuity" method. Its logic implies evaluating what is forgone every year by putting a given sum of money in an investment. There are two elements. One is the interest on the sum of money invested. Such an annual interest is a real cost since it is forgone until the end of the period for which the money is immobilized in the asset. The other element is the annual amount necessary to amortize the sum tied up. With regard to this, such annual amounts must give, with compound interest, the sum invested, since it will be impossible to recover it at the end of the period.

13. Notationally, if the original cost is C, the rate of interest r, and the expected economic life of the asset is n years, and assuming that the asset has no scrap value, then the annual interest charge is rC and the annual amortization charge is that given by $\frac{rC}{(1+r)^n-1}$. The total annual capital charges are therefore equal to:

$$rC + \frac{rC}{(1+r)^n-1} = \frac{rC(1+r)^n}{(1+r)^n-1} = \frac{rC}{1-(1+r)^{-n}}$$

Thus, if a table is available which sets out values of $\frac{r}{1-(1+r)^{-n}}$ the total capital charges can be easily determined by reference to it.[c]

14. In order to illustrate the above formula, the same example as above has been taken ($C = 1{,}000$, $r = 0.05$, $n = 10$). The annual

[a] According to a survey carried out by the UNCTAD secretariat, 89 per cent of the respondents to its second questionnaire (see annex II) indicated that they used the straight-line method.

[b] Assuming that the net value of the asset is correctly evaluated.

[c] Table C gives values of $\frac{r}{1-(1+r)^{-n}}$

capital charges are as set out in the following table B. (Note that such a method satisfies the requirement of paragraph 3 above.)

15. The main advantages of such a method for pricing purposes is that the resulting annual capital charges are constant. Such an advantage is important enough to suggest the use of the amortization method for most of the port's assets. Of course, the application of such a method implies using tables. Nevertheless, the calculations are in the final analysis shorter than where the depreciation method is used, since they can be done once and for all (and not year by year).

B. The question of the scrap value of the asset

16. This problem will be studied in relation to the amortization method; the same notation will be used as above. If the scrap value is S, the sum to be amortized is C−S, thus the annual amortization charge becomes

$$\frac{r(C-S)}{(1+r)^n-1}$$

but the annual interest charge remains unchanged *(rC)*. Thus coming back to the numerical example presented above, with a scrap value of 200, the annual amortization charge would fall from 79.5 to 63.6.[d] The total annual cost would therefore be 63.6 + 50 = 113.6.

C. The question of price increases

17. Although the question of provision for price increases is a different one compared with the calculation of capital charges, it is useful to examine it here.

18. If it is expected at the time of making the investment that the price of the asset will increase at the rate of m per annum, the annuity needed to cover the difference between the future replacement cost and the original price is that given by:

$$\frac{r[C(1+m)^n-C].}{(1+r)^n-1}\ ^{e}$$

This reduces to rC if $m = r$.

---

[d] $\frac{r(C-S)}{(1+r)^n-1} = \frac{C-S}{C} \times \frac{rC}{(1+r)^n-1}$ thus $\frac{1000-200}{1000} \times 79.5 = 63.6.$

[e] Table D gives somes useful values of the formula

$$\frac{r}{(1+r)^n-1}.$$

TABLE A

Straight-line method

	Year										
	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Depreciation charge.		100	100	100	100	100	100	100	100	100	100	Total: 1000
Interest		50	45	40	35	30	25	20	15	10	5	
Total annual capital charges		150	145	140	135	130	125	120	115	110	105	
Coefficient for discounting at year 0		0.95238	0.90703	0.86384	0.82270	0.78352	0.74622	0.71068	0.67684	0.64461	0.61392	
Discounted annual capital charge . .		143	132	121	111	102	93	85	78	71	64	Total: 1000

Source: Calculated by the UNCTAD secretariat.

TABLE B

Amortization method

	Year										
	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Amortization charge		79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	
Interest		50	50	50	50	50	50	50	50	50	50	
Total		129.5	129.5	129.5	129.5	129.5	129.5	129.5	129.5	129.5	129.5	
Coefficient for discounting at year 0		0.95238	0.90703	0.86384	0.82270	0.78352	0.74622	0.71068	0.67684	0.64461	0.61392	
Discounted annual capital charge . .		123	117	112	107	101	97	92	88	83	80	Total: 1000

Source: Calculated by the UNCTAD secretariat.

19. The same numerical example as above may be taken for illustrating the formula $C = 1{,}000 : r = 0.05 : n = 10$. If the expected rate of price increase is 3 per cent, the annual provision needed is 27.3.[f] Of course, such a provision comes in addition to capital charges:

Annual capital charges (amortization method) ...	129.5
Provision for price increase	27.3
Total	156.8

D. How to treat existing assets

20. It often happens in a port that there are existing assets which have been in use for many years and of which the historical cost is not known. In such cases, it is sometimes possible to evaluate their current value and their remaining period of life. For instance, the current value of fork-lift trucks and tractors may be obtained from the second-hand market. In that case, the calculation of annual capital charges may be based on the current value V, and the remaining period of life ℓ. Either the depreciation or the amortization method may be used. If the amortization method is preferred, the formula becomes:

$$\text{Annual capital charges} = \frac{rV}{1-(1+r)^{-\ell}}$$

Where $V = 300$; $\ell = 3$; $r = 0.05$.
the annual capital charges are $300 \times 0.367 = 110.1$.

21. In cases where the current value cannot be accurately evaluated, it is often possible to find out the current replacement cost and the remaining period of life of the asset concerned. In that case, it is not necessary to try to find the historical cost. The current replacement cost *(P)* may be used, but it should be noted that in most cases such a cost will be higher than the historical cost because of price increases. Hence, capital charges determined by applying any method using replacement costs will also include partial provision for price increases.[g]

22. For instance, if the current replacement cost *(P)* of the asset concerned is 1,230, the remaining period of life $\ell = 3$, the interest $r = 0.05$ and the total period of life of the asset $n = 10$, the new annuity will be:

(a) *Straight-line method*

Annual "depreciation" cost:

$$\frac{P}{n} = \frac{1230}{10} = 123$$

Annual "interest" cost:

$$r(P - \frac{(n-\ell)}{n} P) = \frac{Pr\ell}{n} = 18.4$$

at the year considered.

(b) *Amortization method*

New annuity ("interest" and "amortization"):

$$P. \frac{r}{1-(1+r)^{-n}} = 1230 \times 0.129 = 158.7$$

Of course, in both cases, complementary provision may be made for price increases over the remaining period of life.

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[f] $C(1+m)^n - C = 343.9 \frac{r}{(1+r)^n - 1} = 0.079505.$

[g] To determine the pure capital cost, it would be necessary to deflate the current replacement cost, using the formula:

$$\bar{P} = \frac{P}{(1+m)^x}$$

in which $\bar{P}$ = deflated current replacement cost

m = general index of price increase per year of port's assets

x = period of life for which the asset has been in use.

Table E gives some useful values of $\frac{1}{(1+m)^x}$.

TABLE C

Values of the formula $\frac{r}{1-(1+r)^{-n}}$

(r = rate of interest; n = economic life of the asset)

	Rate of interest														
n	*3.0*	*4.0*	*5.0*	*5.5*	*6.0*	*6.5*	*7.0*	*7.5*	*8.0*	*8.5*	*9.0*	*10.0*	*11.0*	*12.0*	*n*
1	1.03000	1.04000	1.05000	1.05500	1.06000	1.06500	1.07000	1.07500	1.08000	1.08500	1.09000	1.10000	1.11000	1.12000	1
2	0.52262	0.53020	0.53781	0.54162	0.54544	0.54927	0.55310	0.55693	0.56077	0.56462	0.56847	0.57620	0.58394	0.59170	2
3	0.35354	0.36035	0.36721	0.37066	0.37411	0.37758	0.38106	0.38454	0.38804	0.39154	0.39506	0.40212	0.40922	0.41635	3
4	0.26903	0.27550	0.28202	0.28530	0.28860	0.29191	0.29523	0.29857	0.30193	0.30529	0.30867	0.31548	0.32233	0.32924	4
5	0.21836	0.22463	0.23098	0.23418	0.23740	0.24064	0.24390	0.24717	0.25046	0.25377	0.25710	0.26380	0.27058	0.27741	5
6	0.18460	0.19077	0.19702	0.20018	0.20337	0.20657	0.20980	0.21305	0.21632	0.21961	0.22292	0.22961	0.23638	0.24323	6
7	0.16051	0.16661	0.17282	0.17597	0.17914	0.18234	0.18556	0.18881	0.19208	0.19537	0.19870	0.20541	0.21222	0.21912	7
8	0.14246	0.14853	0.15473	0.15787	0.16104	0.16424	0.16747	0.17073	0.17402	0.17734	0.18068	0.18745	0.19433	0.20131	8
9	0.12844	0.13450	0.14070	0.14384	0.14703	0.15024	0.15349	0.15677	0.16008	0.16343	0.16680	0.17365	0.18061	0.18768	9
10	0.11724	0.12330	0.12951	0.13267	0.13587	0.13911	0.14238	0.14569	0.14903	0.15241	0.15583	0.16275	0.16981	0.17699	10
11	0.10808	0.11415	0.12039	0.12358	0.12680	0.13006	0.13336	0.13670	0.14008	0.14350	0.14695	0.15397	0.16113	0.16842	11
12	0.10047	0.10656	0.11283	0.11603	0.11928	0.12257	0.12591	0.12928	0.13270	0.13616	0.13966	0.14677	0.15403	0.16144	12
13	0.09403	0.10015	0.10646	0.10969	0.11297	0.11629	0.11966	0.12307	0.12653	0.13003	0.13357	0.14078	0.14816	0.15568	13
14	0.08853	0.09467	0.10103	0.10428	0.10759	0.11095	0.11435	0.11780	0.12130	0.12485	0.12844	0.13575	0.14323	0.15088	14
15	0.08377	0.08995	0.09635	0.09963	0.10297	0.10636	0.10980	0.11329	0.11683	0.12043	0.12406	0.13148	0.13907	0.14683	15
16	0.07962	0.08582	0.09227	0.09559	0.09896	0.10238	0.10586	0.10940	0.11298	0.11662	0.12030	0.12782	0.13552	0.14340	16
17	0.07596	0.08220	0.08870	0.09205	0.09545	0.09891	0.10243	0.10601	0.10963	0.11332	0.11705	0.12467	0.13248	0.14046	17
18	0.07271	0.07900	0.08555	0.08892	0.09236	0.09586	0.09942	0.10303	0.10671	0.11044	0.11422	0.12194	0.12985	0.13794	18
19	0.06982	0.07614	0.08275	0.08616	0.08963	0.09316	0.09676	0.10042	0.10413	0.10791	0.11174	0.11955	0.12757	0.13577	19
20	0.06722	0.07359	0.08025	0.08368	0.08719	0.09076	0.09440	0.09810	0.10186	0.10568	0.10955	0.11746	0.12558	0.13388	20
25	0.05743	0.06402	0.07096	0.07455	0.07823	0.08199	0.08582	0.08972	0.09368	0.09772	0.10181	0.11017	0.11875	0.12750	25
30	0.05102	0.05784	0.06506	0.06881	0.07265	0.07658	0.08059	0.08468	0.08883	0.09306	0.09734	0.10608	0.11503	0.12415	30
35	0.04654	0.05358	0.06108	0.06498	0.06898	0.07307	0.07724	0.08149	0.08581	0.09019	0.09464	0.10369	0.11293	0.12232	35
40	0.04327	0.05053	0.05828	0.06233	0.06647	0.07070	0.07501	0.07941	0.08387	0.08839	0.09296	0.10226	0.11172	0.12131	40
45	0.04079	0.04827	0.05627	0.06044	0.06471	0.06906	0.07350	0.07802	0.08259	0.08722	0.09191	0.10140	0.11102	0.12074	45
50	0.03887	0.04656	0.05478	0.05907	0.06345	0.06792	0.07246	0.07708	0.08175	0.08647	0.09123	0.10086	0.11060	0.12042	50

Source: Calculated by UNCTAD secretariat.

TABLE D

Values of the formula $\frac{r}{(1+r)^n-1}$

(r = rate of interest; n = economic life of the asset)

	Rate of interest														
n	*3.0*	*4.0*	*5.0*	*5.5*	*6.0*	*6.5*	*7.0*	*7.5*	*8.0*	*8.5*	*9.0*	*10.0*	*11.0*	*12.0*	*n*
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1
2	0.49262	0.49020	0.48781	0.48662	0.48544	0.48427	0.48310	0.48193	0.48077	0.47962	0.47847	0.47620	0.47394	0.47170	2
3	0.32354	0.32035	0.31721	0.31566	0.31411	0.31258	0.31106	0.30954	0.30804	0.30654	0.30506	0.30212	0.29922	0.29635	3
4	0.23903	0.23550	0.23202	0.23030	0.22860	0.22691	0.22523	0.22357	0.22193	0.22029	0.21867	0.21548	0.21233	0.20924	4
5	0.18836	0.18463	0.18098	0.17918	0.17740	0.17564	0.17390	0.17217	0.17046	0.16877	0.16710	0.16380	0.16058	0.15741	5
6	0.15460	0.15077	0.14702	0.14518	0.14337	0.14157	0.13980	0.13805	0.13632	0.13461	0.13292	0.12961	0.12638	0.12323	6
7	0.13051	0.12661	0.12282	0.12097	0.11914	0.11734	0.11556	0.11381	0.11208	0.11037	0.10870	0.10541	0.10222	0.09912	7
8	0.11246	0.10853	0.10473	0.10287	0.10104	0.09924	0.09747	0.09573	0.09402	0.09234	0.09068	0.08745	0.08433	0.08131	8
9	0.09844	0.09450	0.09070	0.08884	0.08703	0.08524	0.08349	0.08177	0.08008	0.07843	0.07680	0.07365	0.07061	0.06768	9
10	0.08724	0.08330	0.07951	0.07767	0.07587	0.07411	0.07238	0.07069	0.06903	0.06741	0.06583	0.06275	0.05981	0.05699	10
11	0.07808	0.07415	0.07039	0.06858	0.06680	0.06506	0.06336	0.06170	0.06008	0.05850	0.05695	0.05397	0.05113	0.04842	11
12	0.07047	0.06656	0.06283	0.06103	0.05928	0.05757	0.05591	0.05428	0.05270	0.05116	0.04966	0.04677	0.04403	0.04144	12
13	0.06403	0.06015	0.05646	0.05469	0.05297	0.05129	0.04966	0.04807	0.04653	0.04503	0.04357	0.04078	0.03816	0.03568	13
14	0.05853	0.05467	0.05103	0.04928	0.04759	0.04595	0.04435	0.04280	0.04130	0.03985	0.03844	0.03575	0.03323	0.03088	14
15	0.05377	0.04995	0.04635	0.04463	0.04297	0.04136	0.03980	0.03829	0.03683	0.03543	0.03406	0.03148	0.02907	0.02683	15
16	0.04962	0.04582	0.04227	0.04059	0.03896	0.03738	0.03586	0.03440	0.03298	0.03162	0.03030	0.02782	0.02552	0.02340	16
17	0.04596	0.04220	0.03870	0.03705	0.03545	0.03391	0.03243	0.03101	0.02963	0.02832	0.02705	0.02467	0.02248	0.02046	17
18	0.04271	0.03900	0.03555	0.03392	0.03236	0.03086	0.02942	0.02803	0.02671	0.02544	0.02422	0.02194	0.01985	0.01794	18
19	0.03982	0.03614	0.03275	0.03116	0.02963	0.02816	0.02676	0.02542	0.02413	0.02291	0.02174	0.01955	0.01757	0.01577	19
20	0.03722	0.03359	0.03025	0.02868	0.02719	0.02576	0.02440	0.02310	0.02186	0.02068	0.01955	0.01746	0.01558	0.01388	20
25	0.02743	0.02402	0.02096	0.01955	0.01823	0.01699	0.01582	0.01472	0.01368	0.01272	0.01181	0.01017	0.00875	0.00750	25
30	0.02102	0.01784	0.01506	0.01381	0.01265	0.01158	0.01059	0.00968	0.00883	0.00806	0.00734	0.00608	0.00503	0.00415	30
35	0.01654	0.01358	0.01108	0.00998	0.00898	0.00807	0.00724	0.00649	0.00581	0.00519	0.00464	0.00369	0.00293	0.00232	35
40	0.01327	0.01053	0.00828	0.00733	0.00647	0.00570	0.00501	0.00441	0.00387	0.00339	0.00296	0.00226	0.00172	0.00131	40
45	0.01079	0.00827	0.00627	0.00544	0.00471	0.00406	0.00350	0.00302	0.00259	0.00222	0.00191	0.00140	0.00102	0.00074	45
50	0.00887	0.00656	0.00478	0.00407	0.00345	0.00292	0.00246	0.00208	0.00175	0.00147	0.00123	0.00086	0.00060	0.00042	50

Source: Calculated by UNCTAD secretariat.

TABLE E

Values of the formula $\frac{1}{(1+m)^x}$

(m = general index of price increase of port's assets per year; x = period of life for which the asset has been in use)

	General index of price increase of port's assets per year														
x	*3.0*	*4.0*	*5.0*	*5.5*	*6.0*	*6.5*	*7.0*	*7.5*	*8.0*	*8.5*	*9.0*	*10.0*	*11.0*	*12.0*	*x*
0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	0
1	0.97088	0.96154	0.95239	0.94787	0.94340	0.93897	0.93458	0.93024	0.92593	0.92166	0.91744	0.90910	0.90091	0.89286	1
2	0.94260	0.92456	0.90703	0.89846	0.89000	0.88166	0.87344	0.86534	0.85734	0.84946	0.84168	0.82645	0.81163	0.79720	2
3	0.91515	0.88900	0.86384	0.85162	0.83962	0.82785	0.81630	0.80497	0.79384	0.78291	0.77219	0.75132	0.73120	0.71179	3
4	0.88849	0.85481	0.82271	0.80722	0.79210	0.77733	0.76290	0.74881	0.73503	0.72158	0.70843	0.68302	0.65874	0.63552	4
5	0.86261	0.82193	0.78353	0.76514	0.74726	0.72989	0.71299	0.69656	0.68059	0.66505	0.64994	0.62093	0.59346	0.56743	5
6	0.83749	0.79032	0.74622	0.72525	0.70497	0.68534	0.66635	0.64797	0.63017	0.61295	0.59627	0.56448	0.53465	0.50664	6
7	0.81310	0.75992	0.71069	0.68744	0.66506	0.64351	0.62275	0.60276	0.58350	0.56493	0.54704	0.51316	0.48166	0.45235	7
8	0.78941	0.73070	0.67684	0.65160	0.62742	0.60424	0.58201	0.56071	0.54027	0.52067	0.50187	0.46651	0.43393	0.40389	8
9	0.76642	0.70259	0.64461	0.61763	0.59190	0.56736	0.54394	0.52159	0.50025	0.47988	0.46043	0.42410	0.39093	0.36062	9
10	0.74410	0.67557	0.61392	0.58544	0.55840	0.53273	0.50835	0.48520	0.46320	0.44229	0.42242	0.38555	0.35219	0.32198	10
11	0.72243	0.64959	0.58468	0.55492	0.52679	0.50022	0.47510	0.45135	0.42889	0.40764	0.38754	0.35050	0.31729	0.28748	11
12	0.70138	0.62460	0.55684	0.52599	0.49697	0.46969	0.44402	0.41986	0.39712	0.37571	0.35554	0.31864	0.28585	0.25668	12
13	0.68096	0.60058	0.53033	0.49857	0.46884	0.44102	0.41497	0.39057	0.36770	0.34627	0.32618	0.28967	0.25752	0.22918	13
14	0.66112	0.57748	0.50507	0.47257	0.44231	0.41411	0.38782	0.36332	0.34047	0.31915	0.29925	0.26334	0.23200	0.20462	14
15	0.64187	0.55527	0.48102	0.44794	0.41727	0.38883	0.36245	0.33797	0.31525	0.29414	0.27454	0.23940	0.20901	0.18270	15
16	0.62317	0.53391	0.45812	0.42459	0.39365	0.36510	0.33874	0.31439	0.29190	0.27110	0.25187	0.21763	0.18830	0.16313	16
17	0.60502	0.51338	0.43630	0.40245	0.37137	0.34282	0.31658	0.29246	0.27027	0.24986	0.23108	0.19785	0.16964	0.14565	17
18	0.58740	0.49363	0.41553	0.38147	0.35035	0.32189	0.29587	0.27205	0.25025	0.23029	0.21200	0.17986	0.15283	0.13004	18
19	0.57029	0.47465	0.39574	0.36158	0.33052	0.30225	0.27651	0.25307	0.23172	0.21225	0.19449	0.16351	0.13768	0.11611	19
20	0.55368	0.45639	0.37689	0.34273	0.31181	0.28380	0.25842	0.23542	0.21455	0.19562	0.17844	0.14865	0.12404	0.10367	20
25	0.47761	0.37512	0.29531	0.26224	0.23300	0.20714	0.18425	0.16398	0.14602	0.13010	0.11597	0.09230	0.07361	0.05883	25
30	0.41199	0.30832	0.23138	0.20065	0.17412	0.15119	0.13137	0.11423	0.09938	0.08652	0.07538	0.05731	0.04369	0.03338	30
35	0.35539	0.25342	0.18130	0.15352	0.13011	0.11035	0.09367	0.07957	0.06764	0.05754	0.04899	0.03559	0.02593	0.01894	35
40	0.30656	0.20829	0.14205	0.11747	0.09723	0.08055	0.06679	0.05542	0.04604	0.03827	0.03184	0.02210	0.01539	0.01075	40
45	0.26444	0.17120	0.11130	0.08988	0.07266	0.05879	0.04762	0.03861	0.03133	0.02545	0.02070	0.01372	0.00913	0.00610	45
50	0.22811	0.14072	0.08721	0.06877	0.05429	0.04291	0.03395	0.02689	0.02133	0.01693	0.01345	0.00852	0.00542	0.00347	50

Source: Calculated by UNCTAD secretariat.

ANNEX VI

ALLOCATION OF COSTS

Presented below is the relevant section of the "Freas Formula" as an illustration of how the costs that arise at a port may be allocated *pro rata* on the basis of some cost-related elements.[a] After excluding "non-wharfinger" costs, Freas allocates the total cost of running the wharfinger business initially to ships and cargo and then to the various specific services rendered to each. Where possible, the allocation was made *pro rata* on a time, space or value basis; otherwise, judgement is used.

Costs allocated to ships included:

1. Waterways (i.e. water areas used for berthing of vessels and for making those areas accessible);
2. Fifty per cent of open wharves (exclusive of trackage and other special facilities and their supporting substructures) and of the land on which they are located;
3. Aprons (exclusive of trackage and other special facilities and their supporting substructures);
4. One hundred per cent of the land supporting aprons without tracks, and 50 per cent of the land supporting aprons with tracks;
5. Aisle space within the shed used by the vessel or its agents in receiving cargo at or delivering it to point of rest, together with a proportionate share of the supporting land;
6. Services covered by the so-called service charge;
7. Office and other space used by vessels' clerical forces.

Costs allocated to the cargo included:

1. All land not covered by 1, 2, 4 and 5 above;
2. All trackage and its supporting substructure;
3. Fifty per cent of open wharves (exclusive of trackage and its supporting substructure);
4. Aisle space within sheds not included in 5 above;
5. All cargo areas within sheds;
6. All other trackage, roadways, etc;
7. Any services rendered for the benefit of the cargo.

For the purpose of dividing costs among the various services, aisle space was computed at 30 per cent of the total cargo areas utilized by cargo, whether at rest or in motion, and whether on free time or on demurrage. Aisle space within sheds is apportioned by taking out a proportion corresponding to the average space devoted to demurrage purposes and dividing the remainder among dockage, wharfage, car loading and car unloading and trucking. Loading docks are treated as aisle space chargeable to car and truck loading and unloading.

Of the cost of aprons with tracks, 40 per cent is deemed to be the average of the cost incurred by reason of the tracks. This amount is chargeable to wharfage and the balance to dockage. The return on the land on which the apron rests is charged to dockage if the structure is without tracks, and is divided between wharfage and dockage on a fifty-fifty basis if the structure is equipped with tracks. Costs are computed for space used by car loaders, by truck operators and by the forces doing the ships' clerking.

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[a] See United States of America, *Decisions of the U.S. Maritime Commission, Federal Maritime Board, and Maritime Administration Department of Commerce,* vol. 3, *January 1947 to November 1950* (Washington D.C., U.S. Government Printing Office, 1963), Decision No. 640: "Terminal rate structure – California ports", pp. 61-62.

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