Container Terminal Productivity in Port Jackson from 1977 to 1981

Occasional Paper

This Paper contains an analysis of the productivity of the Glebe Island and Seatainer terminals in Port Jackson over the period 1977 to 1981. The results of this work should not only enhance public understanding of the factors which affect container berth productivity but should also be valuable for future comparison with the productivity of other terminals.

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Container Terminal Productivity in Port Jackson from 1977 to 1981

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FOREWORD

The efficiency with which containers are loaded and unloaded from vessels is important to the carriers, forwarders and receivers of general cargo because it directly affects cargo handling costs. The productivity of container terminals is also important to terminal operators working in a competitive environment. Despite the importance of the topic there is, however, very little data available on the productivity of container terminals either in Australia or overseas. In fact, it appears that this Paper is the first published analysis of its type.

This Paper contains an analysis of the productivity of the Glebe Island and Seatainer terminals in Port Jackson over the period 1977 to 1981. The results of this work should not only enhance public understanding of the factors which affect container berth productivity but should also be valuable for future comparison with the productivity of other terminals.

The Paper is based on a consultant report prepared by Dr R. Robinson of the University of Wollongong, who arranged access to the operational records of the companies who owned the terminals in the study period. Dr Robinson's original report has been extended and edited by Dr H. Milloy and Mr G. Morris of this Branch.

The Bureau gratefully acknowledges the assistance provided by the Maritime Services Board of NSW in the preparation of this Paper.

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SUMMARY

This work was undertaken to assist public understanding of the factors which influence the productivity of container terminals and of the time and other resources required to load and unload container vessels. Much of the work consists of an analysis of the operational records of Glebe Island and Seatainer terminals in Port Jackson in Sydney in the period 1977 to 1981.

Two berths at the Seatainer terminal were commissioned in March 1969 and a third berth was completed in February 1970. The two-berth terminal at Glebe Island, which was designed and operated as a common user facility, became operational in February 1973. Together, these two purpose-built container handling complexes, although limited by small sites of about ten hectares each, were to be the focus of cellular container ship operations in Sydney until early in the 1980s, when two much larger terminals were built on the northern shore of Botany Bay. This Paper includes a description of the development of container terminals in both Port Jackson and Botany Bay from the introduction of containerisation in the 1960s until the opening of the second terminal in Botany Bay in February 1982.

The operations of the Glebe Island and Seatainer terminals in 1977, 1979 and 1981 have been analysed in detail. Both terminals were in a 'mature' phase of operation by 1977, with operational practices well established and early difficulties overcome. The year 1979 represented operations under near peak conditions with each terminal handling about 100 000 twenty-foot equivalent units (TEUs). By 1981 both terminals, but particularly the Seatainer terminal, had begun to show the effects of the development of the Port Botany terminals and of the economic downturn which characterised not only the Australian but also the global economy.

Although both terminals were developed on small sites on adjacent inner city locations, they had few features in common. There were significant differences in the types of equipment used, in the layout of the container stacks and in the operational practices adopted. These differences were partly due to the emphasis given at Glebe Island to the distribution of freight by road and the emphasis at Seatainer to rail transport to the 'decentralised container park' at Chullora in south Sydney.

There were also significant differences between the types of vessels which used each terminal. The average size of the vessels which called at Glebe Island was 18 069 deadweight tonnes (DWT) compared with 25 356 DWT at the Seatainer terminal. Almost 16 per cent of the vessels at Glebe Island were less than 10 000 DWT and only 4.3 per cent were more than 30 000 DWT. For the Seatainer terminal on the other hand, 30 per cent of vessels exceeded 30 000 DWT and only 8 per cent were less than 10 000 DWT. Moreover, as a common user terminal, Glebe Island serviced a less homogenous group of vessels so that even within the same size class there were marked variations in vessel configurations. Vessel loads at each terminal reflected the differences in vessel size and the average loads handled at Seatainer and Glebe Island were 764 and 411 TEUs respectively. Almost one-third of the vessels at the Seatainer terminal exchanged more than 1000 TEUs but only 2 per cent of vessels at Glebe Island handled this number. Apart from the smaller load per vessel call there was greater load variability at the Glebe Island terminal, as might be expected from the less homogeneous traffic pattern at this terminal.

A major part of the study consisted of an analysis of the utilisation of vessel time. The time each vessel spent in port was broken down into such parameters as the

time spent alongside a terminal berth, the time for which labour was assigned to the vessel and the time lost by delays arising from industrial disputes, unfavourable weather conditions and ship equipment breakdowns. These and other parameters were analysed for each terminal for each year and also for the aggregate three year period. These data were then used in conjunction with the numbers of containers loaded and unloaded by each vessel to derive container handling rates.

There were found to be large differences between the times required to service vessels at each terminal. Vessels spent on average more than a day (26 hours) waiting to berth at Glebe Island but only nine hours at the Seatainer terminal. In contrast vessels at Glebe Island spent on average about half as long at berth as vessels serviced at the Seatainer terminal (54 hours compared to 94 hours), because, as shown in the study, the size of vessel loads differed by about a factor of two and container handling rates were the same. Delays due to non-operational factors (industrial disputes, weather etc) represented 11 and 22 per cent of the time vessels spent alongside berths at the Glebe Island and Seatainer terminals respectively.

Two handling rates were derived, an alongside handling rate defined in terms of the containers handled per hour of time alongside berth and a container working rate defined to be the number of containers handled per hour spent loading and unloading. The alongside handling rate for each terminal was nine TEUs per hour and the container working rate for each terminal was 14 TEUs per hour. It can be deduced from the similarities in the handling rates that the differences in the traffic characteristics of each terminal were balanced by differences in terminal design and operation.

Due to lack of data it has not been possible to compare the productivity characteristics of the Glebe Island and Seatainer terminals with any other container terminal. A judgement on whether the container handling rates determined here were good, bad or indifferent must therefore wait until data become available from either other first generation terminals or from second generation terminals, perhaps designed with the help of lessons learnt at the Glebe Island or Seatainer terminals.

CHAPTER 1—INTRODUCTION

Early in 1967, in a period characterised not only by rapid changes in shipping technology, but also by considerable uncertainty about the effects that the then new containerisation technology would have on ports, work was begun on the Seatainer container terminal at White Bay in Port Jackson. This terminal, on 11 hectares of land, became operational in March 1969.

In November 1970, initial plans were finalised and contracts let for the construction of a second container terminal, on a site of 10 hectares, at Glebe Island. Designed as a common user facility, the new Glebe Island terminal became operational in February 1973.

Together, these two purpose-built container complexes, though limited by small sites, were to be the focus of cellular container ship operations in the Port of Sydney until early in the next decade when two much larger terminals were opened at Botany Bay.

This study traces the development of container handling facilities in Port Jackson and Botany Bay and examines the operations and productivities of the Port Jackson terminals at Glebe Island and White Bay during the period 1977–1981. Detailed consideration has been given to the analysis of terminal operations in 1977, 1979 and 1981. Both terminals were in a 'mature' phase of operations in 1977, with operational practices well established and early difficulties overcome. The year 1979 was characterised by operations at more-or-less peak conditions with each terminal handling around 100 000 TEUs or more. By 1981 both terminals had begun to show the effects of the development of the Port Botany terminals and of the economic downturn which characterised not only the Australian but also the global economy.

The data sources for this work were the operational records of each of the two terminals for the years 1977, 1979 and 1981. Three separate sample years were chosen to give a five-year time span, while reducing the work required to analyse five consecutive years. In all, data from 994 ship calls, 595 for the Glebe Island terminal and 399 for the Seatainer terminal at White Bay (Table 1.1), were analysed and the following two distinct sets of variables were created.

The first set described each ship call. Twenty-eight variables, including one control variable, were extracted from confidential ship performance records as follows:

- the timing of the ship calls, ship size (DWT) and ship code;
- 'time' variables for each ship call (four for the Glebe Island terminal and six for the Seatainer terminal) including total port time, time spent alongside, non-operational delay times, gross time for which labour was assigned to the ship and gross and net working times;
- three variables describing handling rates for different work times; and
- a range of variables describing the nature of the container traffic (20' and 40' containers mix, over-dimension and reefer containers carried, number of restows per vessel) for export and import flows.

The data for each terminal were analysed separately and then combined in an overall analysis to obtain an 'average' picture of container handling operations for the major proportion of container traffic in Port Jackson.

TABLE 1.1—SHIP CALLS AT THE GLEBE ISLAND (GIT) AND SEATAINER (STL) TERMINALS; 1977, 1979 AND 1981

	1977		1979		1981		1977, 1979 and 1981	
Month	GIT	STL	GIT	STL	GIT	STL	GIT	STL
January	18	14	23	15	16	15	57	44
February	11	8	21	13	15	8	47	29
March	17	15	24	10	15	9	56	34
April	15	12	19	15	16	8	50	35
May	14	13	19	13	9	10	42	26
June	18	13	23	13	15	11	56	37
July	19	14	16	14	11	6	46	34
August	17	17	14	12	11	6	42	35
September	19	8	12	8	20	11	51	27
October	17	13	19	12	12	9	48	34
November	17	14	18	13	15	9	50	36
December	18	13	18	11	14	4	50	28
Total	200	154	226	149	169	96	595	399

Sources: Records of Glebe Island and Seatainer terminals.

The second set of variables were designed to portray the week-by-week operations and activity at the Glebe Island terminal over the aggregate three year period. Fifteen variables were coded including:

- the number of ships alongside in any one week;
- the number of shifts which ships spent alongside, working, not working and for which labour was unavailable;
- the volume of containers handled each week at the terminal, the proportion received and delivered by road and rail, and the number of men working on a week-by-week basis; and
- equipment downtime, including the number of shifts affected by equipment downtime and the absolute time lost for the two portainer cranes and the five transtainers.

The discussion and analysis presented in this Paper is organised into five chapters after this introductory chapter. Chapter 2 traces the early decisions and events which led to the establishment of container facilities in Port Jackson. It also examines the long progress towards major infrastructural development in Botany Bay and the decentralisation of container facilities from Port Jackson to Botany Bay. A series of tables summarises aspects of the demand for Sydney's container terminals.

Chapter 3 describes the layout, organisation and operational procedures of each of the terminals and summarises their ship and container traffic.

Chapter 4 gives a breakdown of the times spent by container ships using the terminals. The analysis is presented in terms of the times spent in port and alongside berth, working and non-working times and the availability of labour over the duration of a ship's stay at berth. It is however, the relationship between the number of containers handled (and the volume and value of cargo) and the ship time spent in port or at berth which is critical to the analysis of productivity. The second part of the chapter examines various cargo handling rates as indicators of ship and/or terminal productivity.

Chapter 5 examines the week-by-week operations of the Glebe Island terminal and provides a detailed insight into the factors affecting the vessel times and productivity measures reported in Chapter 4.

The final chapter, Chapter 6, summarises the findings of the study.

CHAPTER 2—THE DEVELOPMENT OF CONTAINER FACILITIES IN PORT JACKSON AND BOTANY BAY

In the 1960s it was becoming increasingly apparent that changes in shipping technology, in response to rapidly increasing volumes of cargo, escalating cargo handling costs and inefficiencies inherent in conventional shipping operations, would require both structural and operational changes in ports. Increased tanker sizes, resulting from the closure of the Suez Canal in 1956, prompted port authorities to provide deeper channels and to examine more carefully the implications of larger vessels for port operations. For general cargo shipping, the reduction of terminal rather than linehaul costs necessitated more efficient cargo handling methods rather than increases in vessel size. For port authorities, the elimination of old jetties and finger piers and their replacement with consolidated, longshore berth complexes was an initial response. But for the shipowner, the rationalisation of cargo into standard modules, first pallets and then containers, led quickly to the introduction of roll-on roll-off (Ro-ro) and to cellular container vessels which required specialised and capital-intensive new port facilities.

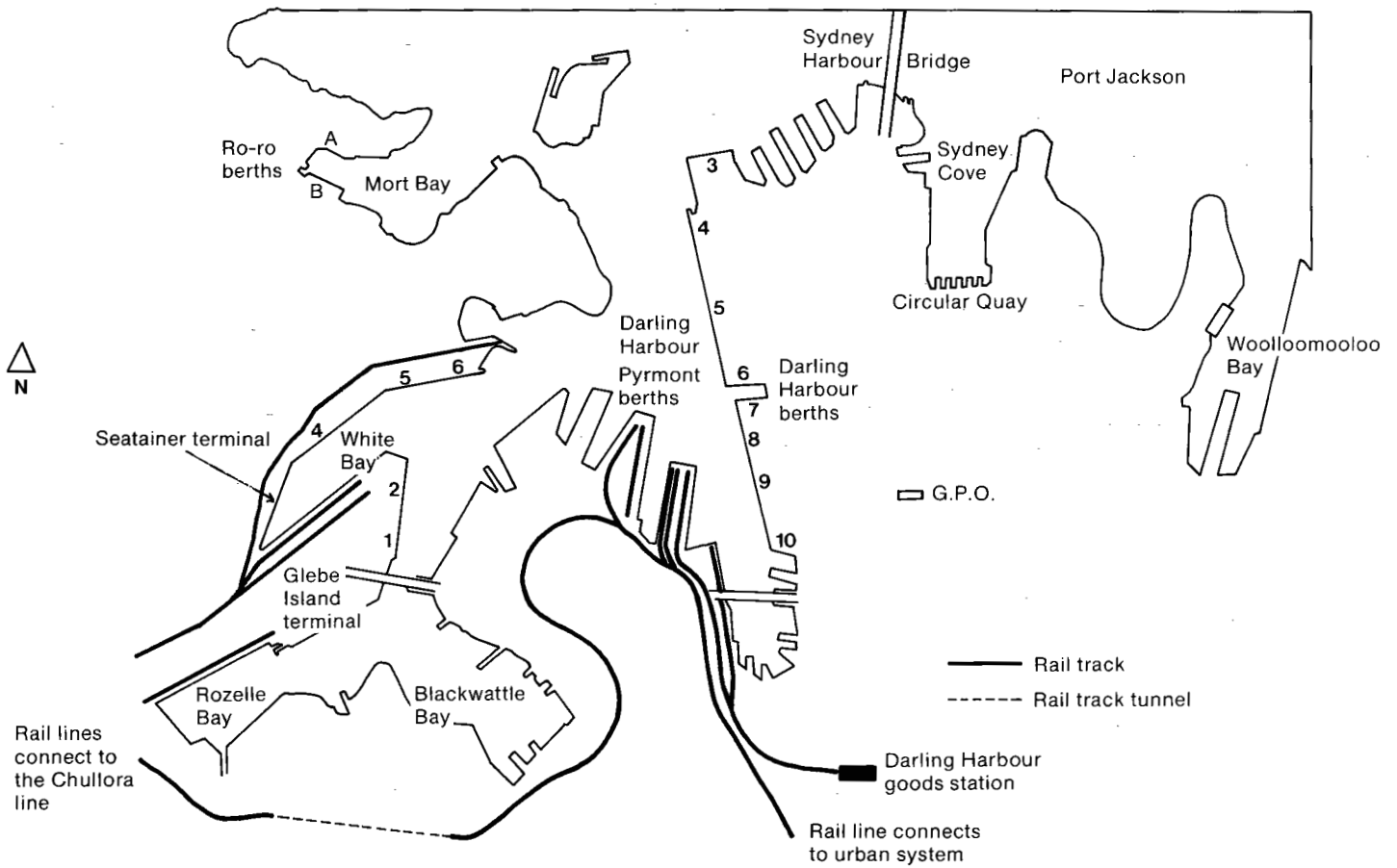
THE DEVELOPMENT OF CONTAINER TERMINALS IN PORT JACKSON

In Port Jackson, the attempt to achieve more efficient general cargo handling operations focussed on the redevelopment of Darling Habour, beginning with the reconstruction of Berth 7 in March 1963. Completed in mid-1964 this berth, designed specifically as a Ro-ro berth to serve interstate trade, and three longshore berths with a total area of 10 hectares, represented the first stage of a ten-year redevelopment program (Maritime Services Board 1974). By 1965 a second berth had been completed and another area of 3.4 hectares at Mort Bay were leased by the Australian National Line (ANL)[1] for development as a Ro-ro terminal, specifically for its Sydney-Tasmania operations (Maritime Services Board 1966). The location of container handling facilities in Port Jackson is shown in Figure 2.1.

For future port development in Sydney, and particularly for the development of container facilities, 1965 was a decisive year. The announcement in London in September 1965 of the formation of two consortia of shipowners, Overseas Containers Limited (OCL) and Associated Container Transportation Limited (ACT), was the single most critical factor in determining the shape, nature and timing of the establishment of container facilities in Sydney. For OCL, containerisation of its United Kingdom-Australia trade was its first priority and, although details of the intent of the new consortia were not clear, the announcement was to create a flurry of activity, apprehension and uncertainty in ports in Australia and elsewhere with strong United Kingdom links. In Hong Kong and Singapore for example, the impression was that if the United Kingdom-Australia trade became containerised, then it was certain that the United Kingdom/Europe-Far East trade would also become quickly containerised (Robinson and Chu 1978).

A high level of uncertainty clearly prevailed at the McEwen conference on containerisation held early in May 1966 in Canberra. Port authorities, in their report to the conference, underlined a number of important issues which were relevant to the development of container facilities in Sydney and other Australian ports

1. Established as the Australian Coastal Shipping Commission by legislation on 1 October, 1956. Further legislation on 18 October, 1974 changed the name to the Australian Shipping Commission, operating as the Australian National Line.



Note: Berth numbers shown are assigned by the Maritime Services Board

Figure 2.1—Location of container handling facilities in Port Jackson

(Department of Trade and Industry 1966). The lack of firm proposals from shipping companies and detailed timetables of operations left ports with tentative plans requiring considerable flexibility. Melbourne and Sydney had been specified as terminal ports, but questions of feeder services and the requirements of feeder ports remained unknown. Problems relating to administrative control over berths and handling areas and the actual areas of land required for container services were not known, and though authorities recognised the likely future need for new, larger areas, they 'considered that careful thought should be given to the potential capacity of existing ports before rushing into the capital expenditure needed to open up new port areas' (Department of Trade and Industry 1966).

The ten-year redevelopment plan for Port Jackson, released by the Maritime Services Board in September 1966, recognised the need to accommodate the demands of containerisation and to meet the 'sweeping changes...becoming apparent in the methods of cargo handling' (Maritime Services Board 1974). It reflected the prevailing uncertainty of whether or not shipping lines would opt for fully cellular vessels or for semi-container vessels and what particular berth layouts would be required for container operations. There was, therefore, considerable emphasis on the flexibility available within the plan and its possible adaptation to the need for sheds at container handling berths.

The focus for container operations in Port Jackson was to be along 'the White Bay foreshore of the Balmain peninsula' (Maritime Services Board 1966), an area not previously developed by the Maritime Services Board, but which had been designated as a site for conventional cargo handling facilities and for which preliminary design work had already been initiated (Maritime Services Board undated a). Details for the new terminal were sketchy, pending further negotiations with OCL.

Modifications to the White Bay terminal were made with the progressive realisation of the plans of OCL. In May 1966, Seatainer Terminals Limited was incorporated as a proprietary company in Victoria to construct and operate container terminals in Fremantle, Melbourne and Sydney (and tentatively at that time, in Brisbane) (Seatainer Terminals Limited 1976). The company, equally owned by Overseas Containers Australia Proprietary Limited (OCAL), the Australian subsidiary of OCL, and Associated Steampships Proprietary Limited (ASP), a wholly-owned subsidiary of Bulkships Limited (itself equally owned by McIlwraith McEachern Limited and the Adelaide Steamship Company Limited), negotiated with the Maritime Services Board for the lease of the 3.2 hectares site as its base for handling the OCL operations. Somewhat later however, OCL and ACT agreed to operate integrated services between Australia and Europe. As a result, Seatainer Terminals Limited negotiated a lease for 4.9 hectares rather than the smaller portion (Brotherson 1967). Reclamation and construction began on the site in January 1967 with the expectation that the two berths would be completed by the end of 1968 (and that a further 3.2 hectares to the west and another 850 feet of berth frontage would be available by mid-1969) (Brotherson 1967).

Two other areas were specified for container development. The first, in Mort Bay, was an area of 3.4 hectares leased earlier to ANL for development as a container and steel handling depot for the interstate trades. The second area, Berths 7 to 10 in Darling Harbour, was part of the general reconstruction program of the finger piers in Darling Harbour and was designed to accommodate conventional, Ro-ro and part-container vessels.

In Darling Harbour, the redevelopment of the central area as stage 1 of the general redevelopment plan, began in mid-1964 with the opening of the new Berth 7 and ended with the commissioning of Berth 10 in September 1968. This stage added 10 hectares to existing capacity and included 2.5 hectares of covered space (Maritime Services Board 1974). The second stage of redevelopment, for the northern sector of Darling Harbour, was 'brought ahead of the original schedule' in an 'accelerated

program...directly related to the rapid changes taking place in cargo handling methods and the ever increasing need for spacious berths with large transit sheds to cope with the quick turn-around of the modern unit load type vessels' (Maritime Services Board 1968). Berth 6 was commissioned in September 1972 and Berth 5 in August 1974; but it was not until November 1977 and April 1981 that Berths 4 and 3 respectively were commissioned and the second stage of the Darling Harbour redevelopment was completed.

The two-berth terminal at Glebe Island was not part of the 1966 ten-year redevelopment plan. The initial contract for the development of the terminal, involving extensive reclamation and consolidation, was let in November 1970 (Maritime Services Board 1973) and the edrminal was opened as a common user facility in February 1973. Operated initially by the Maritime Services Board the terminal was taken over by Glebe Island Terminals Proprietary Limited in November 1974. The company, owned equally by Farrell Lines (United States), Liner Services Pty Ltd (Australia), Patrick Operations Pty Ltd (Australia) and Columbus Line (Germany) represented strong Australian and overseas interests in shipping, stevedoring and land transport.

In early 1983 Farrell Lines withdrew from its Australian shipping operations and this precipitated the takeover of Glebe Island Terminals by Patrick Operations Pty Ltd.

It follows from the above discussion that there was rapid development of container terminals in Port Jackson from the introduction of specialised container vessels in the late 1960s until the Glebe Island terminal was completed in early 1973. Since then the rate of development in Port Jackson has been much slower and has been confined to the redevelopment of Berths 3, 4 and 5 in Darling Harbour. This decrease in the rate of infrastructure development in Port Jackson was at least partly due to the development of terminal facilities in Botany Bay.

THE DEVELOPMENT OF CONTAINER TERMINALS IN BOTANY BAY

In May 1961 the Martitime Services Board obtained jurisdiction over Botany Bay as a potential site for future port development. Factors in this decision were the inadequacy of Port Jackson for the development of extensive bulk handling areas and the forecast increases in ship size, particularly for crude oil movements (Brotherson 1969).

Although the Maritime Services Board had developed plans for crude oil handling in Botany Bay as early as 1956, interest in the Quibray Bay area, as a relatively protected shoreline capable of consolidation by reclamation for port development and for possible extensions to the airport, prompted detailed investigations of its hydraulic and meteorological characteristics. In July 1962, British consultants were commissioned to examine the hydraulic characteristics of Botany Bay and later in July 1964, further detailed analysis attempted to assess the stability of bed sediments and material, particularly under storm conditions (Brotherson 1969).

These studies established that under certain conditions it would be possible to develop and maintain deep channels for use by very large vessels. Whether or not it was economically feasible to develop port facilities in the Quibray Bay area or whether it was desirable to establish facilities closer to the urban areas of Sydney, on the northern foreshores of Botany Bay, remained unknown. Early in 1965, the Maritime Services Board again commissioned consultants to evaluate both possibilities, although initial terms of reference included only the former. By September 1965 however, the Kurnell Peninsula Development Committee, an Inter-Departmental Committee appointed earlier by the New South Wales Minister for Local Government to consider the question of zoning and acquisition of land, had made a formal recommendation to the Minister that land in the Quibray Bay area be reserved and zoned for port development. Later in January 1966, the report was referred to the Maritime Services Board for evaluation and comments (Botany Bay Port and Environment Inquiry 1977).

In April 1966 the initial consulting report on the economic feasibility of port development became available and was followed in May by the first report on the hydraulic behaviour of Botany Bay (Botany Bay Port and Environment Inquiry 1977). The technical reports indicated that port development was feasible if storm waves could be excluded from the Bay. A tentative proposal for the construction at the entrance of 'massive breakwaters armoured with rock and concrete' was made, though without detailed research (Maritime Services Board undated b).

In June 1967 and later in November 1967, further consulting reports on the hydraulic behaviour of the Bay and on the engineering and economic feasibility of port development in the Bay had been completed and on the basis of these reports the Maritime Services Board, in its letter to the Premier in February 1968, urged that the earlier breakwater proposal be abandoned. It suggested instead, that wave action at the entrance and the severe effects of storm waves on navigation could be minimised by configuration dredging, which would result in the deflection of waves and thereby cause wave energy to be dissipated or absorbed in particular locations. By the end of 1968 and after further research, a more detailed plan for configuration dredging, plus an armoured embankment and a reclamation area became the basis for future development (Silva 1978). On 18 March 1969, the Premier announced 'that the Government had adopted a proposal for the development of the northern foreshore of Botany Bay...for port and industrial purposes' (Botany Bay Port and Environment Inquiry 1977).

The dredging of the port approaches and the initial reclamation work began in 1971 and were completed by 1973. In March 1974, although much reclamation work remained to be done, the Maritime Services Board invited applications for the lease of the proposed new sites. In February 1975 a contract was let for the construction of a bulk liquids berth and the first lease agreement was concluded to provide a tank storage area for liquids pumped from ships at the berth (Maritime Services Board 1975a). Not surprisingly, both ANL and Seatainer Terminals Limited, and later the Container Terminals Australia Ltd (CTAL) group, began negotiations for the lease of large areas proposed for container terminals. In December 1975 ANL secured the lease for a 42.2 hectare site on the northern side of a new dock and 'negotiations were well advanced for the leasing of a further 38.6 hectares to a consortium of eight container shipping companies', although it was not until February 1978 that CTAL finally secured the lease for the southern terminal (New South Wales Government Commission of Inquiry into the Kyeemagh-Chullora Road 1981, p309).

By the end of 1975 therefore, it was apparent that there would be major container terminal development in Botany Bay as well as in Port Jackson, though a long lead time was expected, 'the first two wharves are expected to be in operation by mid-1977, the second two wharves by mid-1978, while all six wharves are planned to be in operation during 1981' (Maritime Services Board 1975b).

However the long and complex process of the implementation of major infrastructural developments was further complicated by political change and by the processes of decision-making.

From its inception, the Botany Bay development program was designed to provide sites for terminals able to handle large ships, particularly liquid and dry bulk carriers, and as an industrial area ideally located within the Sydney urban area. By 1974, the distinct advantages of Botany Bay as a possible site for dry bulk handling operations, particularly coal, had become apparent to a consortium of coal companies (Austen and Butta Limited, Clutha Development Proprietary Limited and Coalex Proprietary Limited). Deep draft shipping channels, an extensive flat site, relatively easy (or easily provided) rail access from western and south-western coal fields and likely economic advantages all made Botany Bay an attractive site. In July 1974 the companies submitted a proposal and an Environmental Impact Statement to the Maritime Services Board for the construction of a coal loader in Botany Bay. In November 1975, the proposal was the subject of an enquiry by the State Pollution

Control Commission and in May 1976, a revised proposal was submitted to the Maritime Services Board (Botany Bay Port and Environment Inquiry 1977).

The question of the further development of Botany Bay and in particular the building of a coal loader became highly politicised. Following the change of New South Wales Government in May 1976 work was suspended on further development of Botany Bay pending a full enquiry. In June 1976, the new Premier appointed a commissioner

> 'to enquire into the role of the port in terms of the needs of the State;...to enquire into the environmental impact including social and economic aspects of the existing and planned projects within the port development;...to make recommendations on the future of the planned port development and, if necessary, make alternative proposals' (Silva 1977).

The further development of container facilities in Botany Bay depended therefore on the outcome of the enquiry. In the event, and after a delay of seven months, the New South Wales Government in January 1977 approved the recommendation of the enquiry that the construction of the container terminals 'should proceed forthwith but subject to certain controls directed to minimisation of the impacts on the environment' (Botany Bay Port and Environment Inquiry 1977). (The enquiry recommended that the coal loader project should not proceed).

From the time of this announcement three years were to elapse before the northern terminal, leased to ANL, began operations[1] and another two years before the CTAL terminal commenced operating in February 1982.

THE DEMAND FOR SYDNEY'S CONTAINER TERMINALS

In the first two sections of this chapter an outline has been given of the development of container terminal infrastruture in Sydney. The purpose of this section is to describe the demand for terminals in terms of ship calls and container movements and to relate some of the demand characteristics to infrastructure developments.

TABLE 2.1—CALLS BY CELLULAR CONTAINER AND RO-RO VESSELS AT PORT JACKSON AND BOTANY BAY; 1968-69 TO 1981-82

(Number of vessel calls per year)

	Port Jackson		*Botany Bay*[a]		
Year	*Container*	*Ro-ro*	*Container*	*Ro-ro*	*Total*
1968-69	13	128	..	..	141
1969-70	137	213	..	..	350
1970-71	157	293	..	..	450
1971-72	200	334	..	..	534
1972-73	222	360	..	..	582
1973-74	248	377	..	..	625
1974-75	319	371	..	..	690
1975-76	337	424	..	..	761
1976-77	389	351	..	..	740
1977-78	483	326	..	..	809
1978-79	541	298	..	..	839
1979-80	509	260	33	22	824
1980-81	387	191	140	100	818
1981-82	349	198	184	106	837

a. Container terminal operations commenced in March 1980.

Source: Maritime Services Board (1969-82).

1. The berth was opened in December 1979, but began operations in March 1980.

Details of the numbers of vessel calls by cellular container and Ro-ro vessels from 1968-69 to 1981-82 are given in Table 2.1. From 1969-70, the first full year of cellular container operations in Sydney, to 1981-82, container vessel calls increased on average by 11 per cent per year, whereas calls by Ro-ro vessels increased by 3 per cent per year on average.

The growth in general cargo passing through Sydney between 1968-69 and 1981-82 is shown in Table 2.2, together with details of the containerised cargo. Over this 14-year period the general cargo trade increased by about 5 per cent per year on average. It took nine years for the fraction of containerised general cargo to reach a plateau value of about 68 per cent of total general cargo.

TABLE 2.2—GROWTH IN GENERAL CARGO TRADE THROUGH PORT JACKSON AND BOTANY BAY; 1968-69 TO 1981-82

Year	*Total general cargo (million tonnes)*	*Containerised general cargo (million tonnes)*	*Containerised (per cent)*
1968-69	4.94	0.17	3
1969-70	5.88	1.21	21
1970-71	6.49	1.85	29
1971-72	6.42	2.36	37
1972-73	7.18	2.97	41
1973-74	7.82	4.16	53
1974-75	8.70	4.34	50
1975-76	7.68	4.69	61
1976-77	9.02	5.41	60
1977-78	8.12	5.20	64
1978-79	8.85	6.06	68
1979-80	9.01	6.14	68
1980-81	9.81	6.52	66
1981-82	10.29	6.86	67

Source: Maritime Services Board (1969-82).

The numbers of containers handled at each of the main container terminals in Sydney from 1969-70 to 1981-82 are detailed in Table 2.3 and plotted in Figure 2.2. The proportion of the total container traffic handled at each of the main terminals is plotted in Figure 2.3 and shows the growing emergence of Botany Bay as the primary terminus for general cargo.

Figure 2.2 shows that in the 12-year period the number of containers handled annually in Sydney increased by more than a factor of four. The high growth rate experienced in the early 1970s was not sustained later in the decade: the average annual increases in container movements in the first and second halves of the decade were 23 and 7 per cent respectively.

From 1973-74 to 1979-80 container throughput at the White Bay terminal was about 110 000 TEUs per year. At the Glebe Island terminal the number of containers handled increased from 59 366 to 99 157 and at the other container berths in Port Jackson (including Mort Bay) the throughput increased from 77 730 to 138 920. In 1980-81 the ANL terminal in Botany Bay became operational and this must have contributed to the general reduction in container throughput in Port Jackson. However, it is interesting to note that there was an increase in demand for Port Jackson terminals (other than White Bay) in 1981-82 despite the growth in container throughput in Botany Bay.

One of the most noticeable features of the variation of total container movements with time (see Figure 2.2) is the large increase observed in the 1973-74 financial

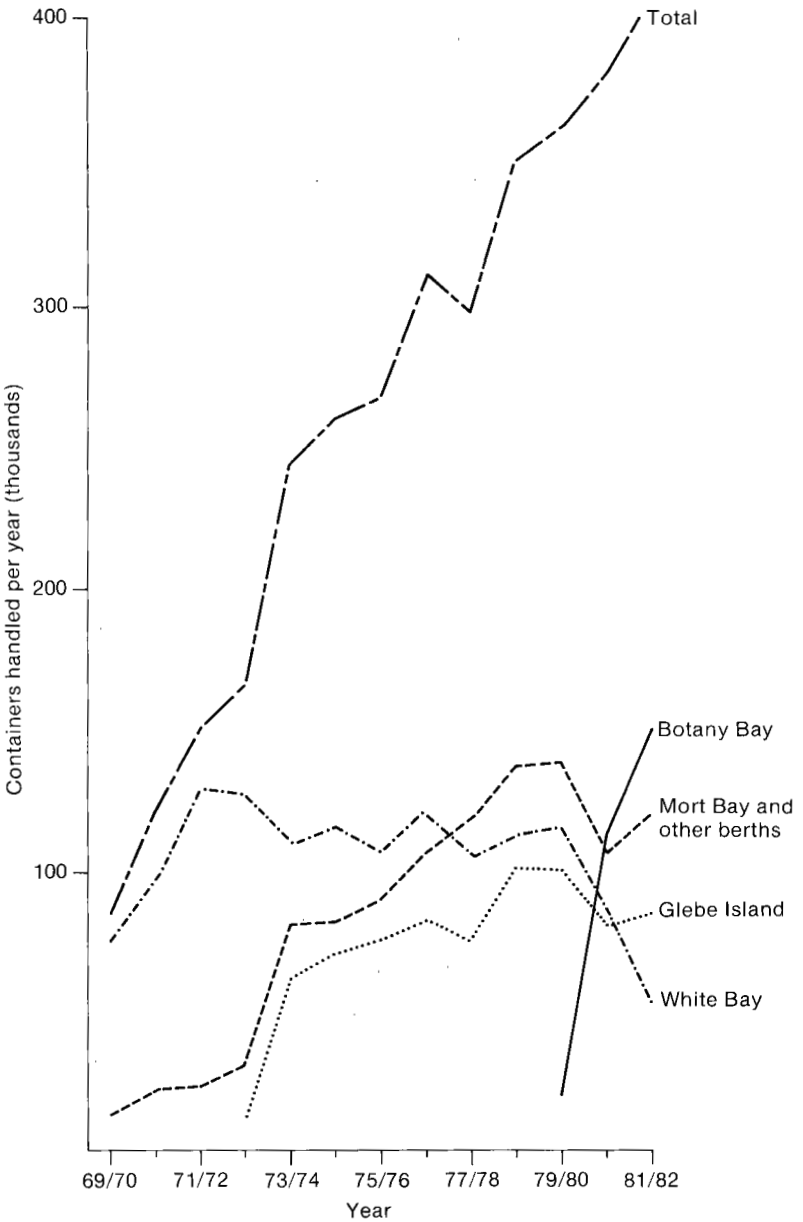


Figure 2.2—Containers handled at facilities in Port Jackson and Botany Bay, 1969-70 to 1981-82

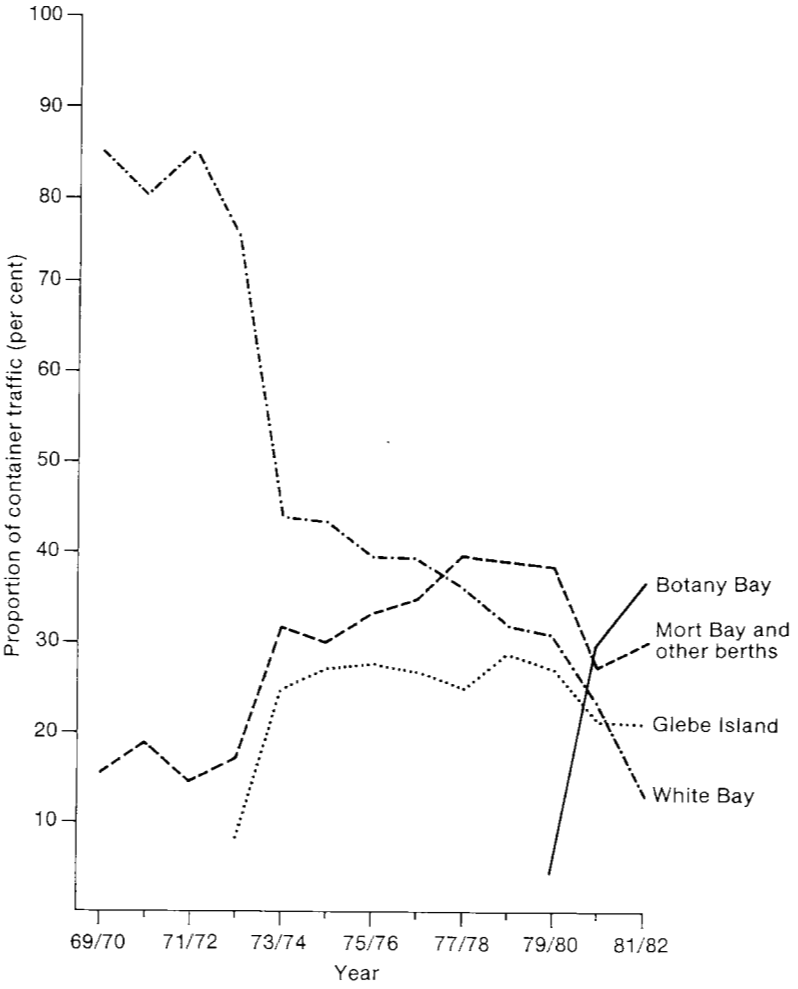


Figure 2.3—Proportion of containers handled at facilities in Port Jackson and Botany Bay, 1969-70 to 1981-82

year. The 243 745 TEUs handled in that year represented a growth of 47 per cent over the total for the previous year. This abnormally high growth was due in part to the revaluation of the Australian dollar and the reduction in tariff levels by the Whitlam Government. As the Glebe Island terminal was opened in February 1973 it was clearly able to take advantage of this rapid increase in the general cargo trade. In fact Glebe Island terminal took 60 per cent of the increase in container movements between 1972–73 and 1973–74.

The reduction in containers handled in 1977–78 (see Figure 2.2) was probably at least partly due to the 17.5 per cent devaluation of the Australian dollar by the Fraser government in November 1976 and the consequent increases in the prices of imported goods.

The data listed in Table 2.3 represent total flows of full and empty containers in both the coastal and overseas trades. In Port Jackson, the White Bay and Glebe Island terminals handled overseas traffic almost exclusively, while the remaining cargo handling areas at Mort Bay, Darling harbour, Pyrmont and Wollomolloo handled both coastal and overseas traffic. (The ANL terminal at Botany Bay handled both coastal and overseas traffic though in separate stacking areas.) Table 2.4 shows the flows of overseas container traffic for Port Jackson and Botany Bay and clearly demonstrates the significant imbalance between the import and export flows. Up to twice as many full containers were imported each year than were exported, reflecting the fact that Sydney is a net importing port for general (non-bulk) cargo. The table also shows that net inflows of full containers were greater than net outflows of empty containers. This imbalance is largely redressed by significant internal (interstate and intrastate) outflows of empty containers (Bureau of Transport Economics 1981).

TABLE 2.3—CONTAINERS HANDLED AT FACILITIES IN PORT JACKSON AND BOTANY BAY; 1969–70 TO 1981–82

(TEUs)

	Port Jackson					
Year	*White Bay*	*Glebe Island*[a]	*Mort Bay*[b]	*Other berths*	*Botany Bay*[c]	*Total*
1969–70	71 946	..	3 786	9 286	..	85 018
1970–71	96 517	..	9 472	11 996	..	117 985
1971–72	127 981	..	9 975	12 292	..	150 248
1972–73	124 763	12 684	11 931	16 602	..	165 980
1973–74	106 649	59 366	34 400	43 330	..	243 745
1974–75	114 252	69 436	37 812	40 666	..	262 166
1975–76	106 313	73 977	41 137	46 455	..	267 882
1976–77	122 819	81 165	43 162	64 162	..	311 308
1977–78	107 476	73 766	39 332	77 658	..	298 232
1978–79	111 505	99 796	47 391	90 645	..	349 337
1979–80	111 818	99 157	35 172	103 748	17 452	367 347
1980–81	87 023	80 462	..	104 823	111 272	383 580
1981–82	51 772	84 836	..	122 338	149 848	408 794

a. Glebe Island terminal was opened in February 1973.
b. The Australian National Line ceased operations at Mort Bay in April 1980 following the opening of the Botany Bay container terminal.
c. Container terminal operations commenced at Botany Bay in March 1980.

Sources: For 1969–70 to 1978–79, New South Wales Government Commission of Inquiry into the Kyeemagh-Chullora Road (1981, p14); for 1979–80 to 1981–82, personal communication from the Maritime Services Board.

TABLE 2.4—FLOWS OF FULL AND EMPTY CONTAINERS IN THE OVERSEAS TRADE; PORT JACKSON AND BOTANY BAY, 1969–70 to 1981–82

	Full containers				*Empty containers*				
Year	*Inward*	*per cent of total*	*Outward*	*per cent of total*	*Inward*	*per cent of total*	*Outward*	*per cent of total*	*Total*
1969–70	32 754	(55.3)	14 917	(25.2)	2 282	(3.9)	9 233	(15.6)	59 186
1970–71	49 914	(56.3)	28 583	(32.3)	2 448	(2.7)	7 669	(8.7)	88 614
1971–72	66 196	(54.5)	38 918	(32.0)	2 629	(2.2)	13 726	(11.3)	121 469
1972–73	78 792	(56.6)	46 236	(33.2)	2 068	(1.5)	12 164	(8.7)	139 260
1973–74	110 862	(55.2)	50 327	(25.0)	1 416	(0.7)	38 364	(19.1)	200 969
1974–75	114 045	(51.5)	57 177	(25.9)	3 845	(1.7)	46 259	(20.9)	221 326
1975–76	128 612	(54.9)	67 337	(28.8)	3 467	(1.5)	34 995	(14.9)	234 411
1976–77	151 277	(53.8)	79 834	(28.3)	5 204	(1.9)	45 109	(16.0)	281 424
1977–78	140 353	(52.3)	86 128	(32.1)	10 335	(3.8)	31 611	(11.8)	268 427
1978–79	158 557	(50.7)	99 551	(31.8)	13 540	(4.3)	41 345	(13.2)	312 993
1979–80	164 439	(49.9)	99 861	(30.3)	14 927	(4.5)	50 473	(15.3)	329 700
1980–81	178 792	(51.4)	101 068	(29.1)	13 298	(3.8)	54 489	(15.7)	347 647
1981–82	197 369	(53.1)	97 844	(26.4)	9 114	(2.5)	66 760	(18.0)	371 087

Source: Maritime Services Board (1969–1982).

CHAPTER 3—THE GLEBE ISLAND AND SEATAINER TERMINALS: OPERATIONAL ORGANISATION, SHIP AND CONTAINER TRAFFIC

BACKGROUND

Uncertainty characterised the introduction of containerisation into Australian ports, and for that matter, into most ports around the world. Little was known, for example, about the size and type of vessels which would be used in container trades, their scheduling, the number of containers likely to be carried, the rate at which general cargo would be containerised and land space requirements. What did appear certain was that once a decision had been made to containerise particular routes, port facilities on those routes would require immediate major modifications, usually by the construction of purpose-built terminals to accept the new vessels and their highly specialised requirements (Robinson and Chu 1978).

The Seatainer and Glebe Island terminals were the products of this immediacy and uncertainty. Their designs were largely conditioned by the responses which the British shipowners in the two new consortia had made to old city port locations in London (Tilbury) and elsewhere in which alongside space was extremely limited. Thus, limited space in Port Jackson, uncertainty of the landside space demands of the new handling technology, the development in the United Kingdom of the Containerbase system of inland container depots (six depots were opened in 1968 for example (Macdiarmid and Chambers 1978)) and the Freightliner rail operations (Howard 1978) for transferring containers to and from inland points were key design factors for the new Seatainer terminal at White Bay. The corporate pattern of ownership was also important because, as shipowners, the corporate emphasis was on ship productivity factors such as the rationalisation of services and the minimisation of ship calls and port time.

When the new Seatainer terminal was opened in March 1969 therefore, it was characterised by an inner city location, a restricted site, high density stacking and an integrated inland container depot (or container freight station) serviced by a specialised rail service.

In February 1970, an additional berth (Number 4) was opened at the Seatainer terminal to serve as a common user facility until a second terminal at Glebe Island became operational in February 1973. At Glebe Island space was also limited, but in the four years since the construction of the Seatainer terminal, container terminal design had become more flexible and innovative and a low level stacking, transtainer operation was adopted. Initially operated by the Maritime Services Board, the terminal was taken over in 1974 by Glebe Island Terminals Proprietary Limited, a company whose shareholders represented not just shipowners but also stevedoring and land transport interests. Though the terminal was linked by rail to two inland depots, the Associated Container Transportation (Australia) Limited (ACTA) Freightbases' depot at Villawood and Seatainer Terminals Limited's depot at Chullora, these links were not an integral part of the terminal operation and road receivals and deliveries were very important.

Although both teminals had restricted sites and were in adjacent inner city locations, they were nevertheless fundamentally quite dissimilar in many respects. In the following sections, the differences in layout and operational organisation, the trades

served, the sizes and types of vessels handled and the container throughputs are examined in detail to provide a basis for interpretation of ship and terminal productivity.

ORGANISATION OF TERMINAL OPERATIONS

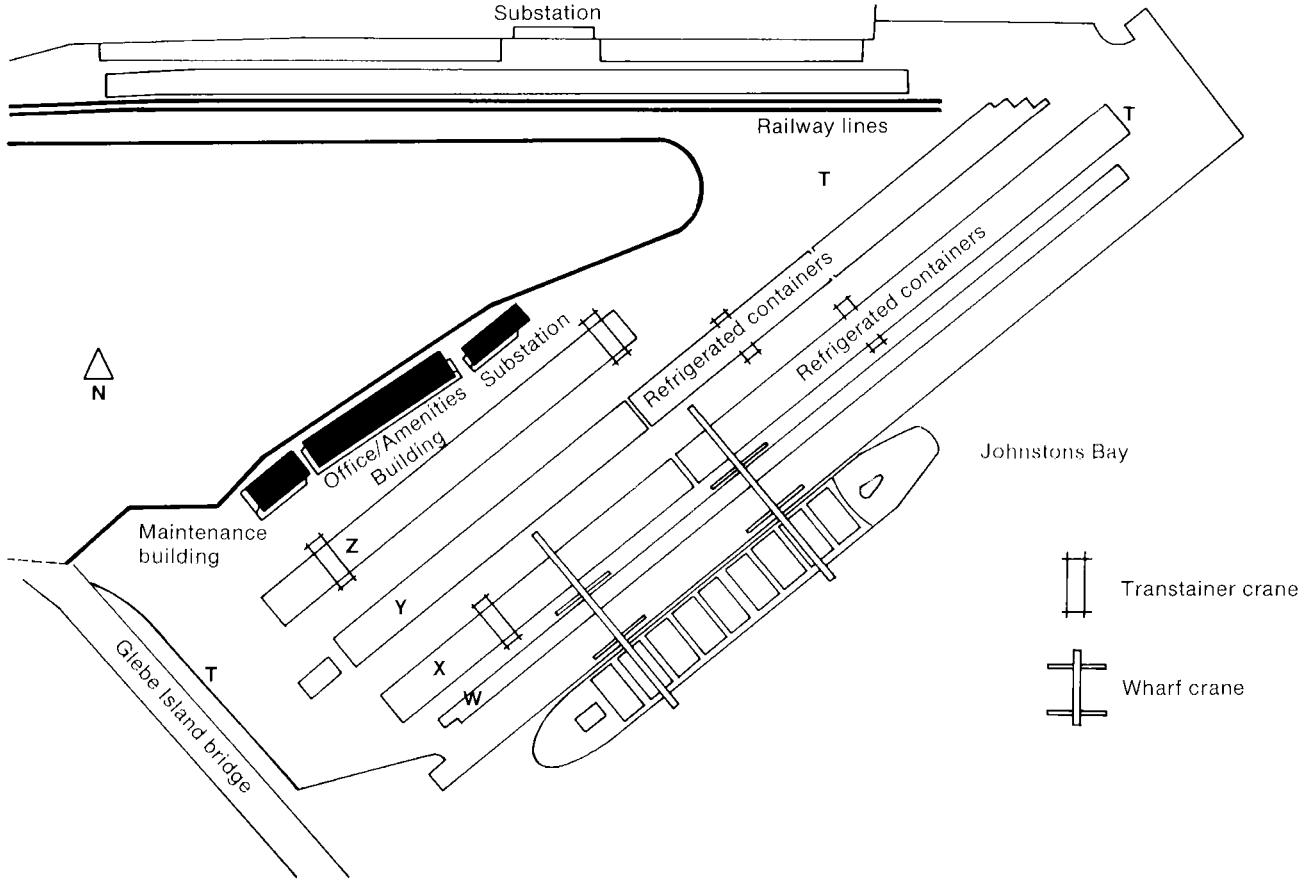
Some of the basic characteristics of the terminals are set out in Table 3.1. Figures 3.1 to 3.4 illustrate the site layouts of the two terminals and Figure 3.5 shows the layout of the Chullora depot linked to the Seatainer terminal at White Bay.

TABLE 3.1—TERMINAL CHARACTERISTICS, GLEBE ISLAND AND SEATAINER TERMINALS

Characteristic	*Glebe Island*	*Seatainer*
Date of initial contract	November 1970	January 1967 (work started)
Date commissioned/opened	February 1973	March 1969 (eastern section) February 1970 (Berth Number 4)
Operator	MSB initially but control assumed by Glebe Island Terminals Pty Ltd in November 1974	Seatainer Terminals Ltd
Land area	9.7 ha	10.9 ha
Length of berthage	468 m	680 m
Number of berths	2	3
Depth alongside	12.2 m	11.0 m
Wharf cranes	2	3
Crane capacity single lift	36 tonnes	46 tonnes
heavy lift	63 tonnes	66 tonnes
Yard equipment	5 transtainers (30 tonnes capacity)	3 overhead cranes (in 5-high stacking area) (46 tonnes capacity)
	tractors, trailers and forklifts	initially straddle carriers, then forklifts plus tractors and trailers

Glebe Island terminal

The 9.7 hectare site of the Glebe Island terminal lies adjacent to the major grain handling facility in the port with road and rail access as shown in Figures 3.1 and 3.2. Three major stack areas are laid out for transtainer operations: X stack is for both import and export containers, Y stack is for exports, with both stacks having slots for refrigerated containers (reefers) and with 40 foot containers normally placed at the northern end of the two stacks; Z stack is for 20 foot import containers stacked in a six-across two-high configuration with a 'desirable' six-down three-up (six containers on the ground and three containers on top) pattern to allow for ease of access to ground containers and minimal transtainer moves. The W or wharf stack has a three-across pattern compared with the six-across configuration in the other three stacks and tends to be used as a temporary or back-up stack. Temporary holding areas (T) are utilised in three locations as shown in Figure 3.1. The total number of ground slots available on the terminal is 1535 with a total stack capacity of 3397 TEUs. There is provision for 384 reefer containers on power.



Note: W, X, Y, Z are container stack areas; T areas were used as temporary holding areas

Figure 3.1—Glebe Island terminal layout

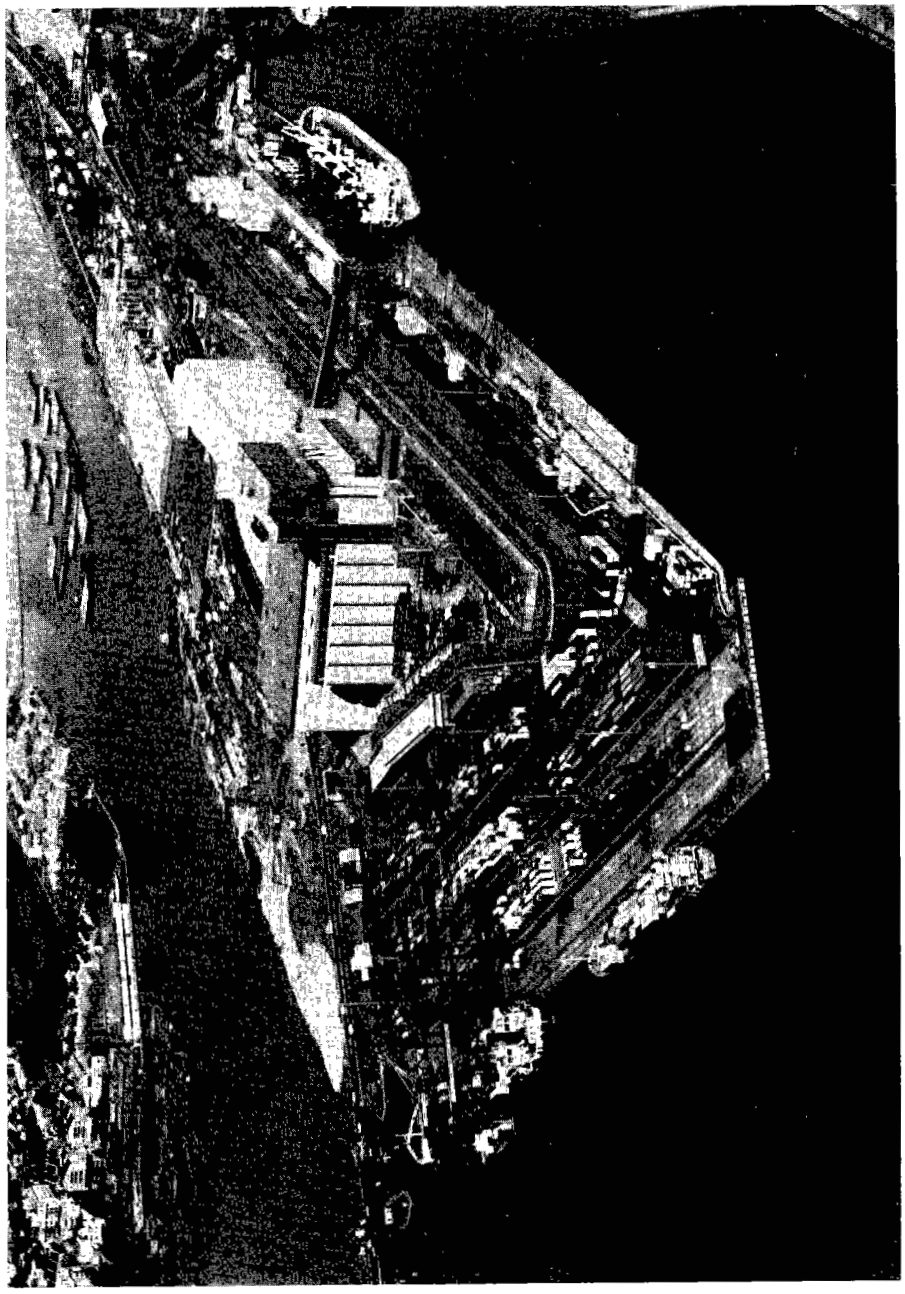


Figure 3.2—Glebe Island terminal (photography courtesy of Aerovision Photography, Sydney).

Import containers are handled from the ship onto internal transfer vehicles (ITV's) and transferred into either the Z or X stack, with priority given to the Z stack to minimise truck movements within the terminal. If these stacks are full, use is then made of the wharf stack (W) or else containers are stacked in temporary holding areas for later sorting and delivery. Export containers are received either from road or rail and are placed into the Y stack.

With an estimated optimal capacity of 60 000 TEUs per year, the terminal was under pressure almost from its inception (see Table 2.3) and the restricted site area created significant problems for container storage and vehicle movement, which in turn had significant impacts on crane exchanges and ship productivity. Thus, although the terminal cranes could sustain high handling rates, yard congestion and the inability to store and/or quickly evacuate large numbers of containers often held vessels at the berth for longer than otherwise would have been the case.

That the terminal was able to achieve throughputs significantly above the optimal capacity clearly reflected more than a little on good management and operational planning and on the considerable modification of some operational practices. Limited truck pick-up and delivery times, from 7.30 am to 5.00 pm for only five days of the week, created problems which were partly overcome by a vehicle booking system and, for example, by the pre-positioning of containers in evening shifts for quick delivery the next day. Consolidation of some part-empty (less than container load or LCL) containers away from the general stacks for delivery at specified times helped minimise truck intrusions into ITV traffic areas.

Constraints on the availability of space, the high volumes of container traffic and the difficulties involved in quickly moving containers to and from the terminal in large volumes appear to have been major determinants of ship and berth productivity. These constraints were not unique to the Glebe Island terminal, though for a similar site area of nearly 11 hectares, a quite different layout and operational organisation emerged at the Seatainer terminal.

Seatainer terminal

The terminal had three berths, rather than two as at Glebe Island, with three twin-lift wharf cranes (Figures 3.3 and 3.4). A large, part-covered five-high stacking area with a capacity of 1985 TEUs including 240 reefer containers (McSporran 1978) was serviced by three twin-lift overhead rail-mounted gantry cranes and provided the major area of concentration, at least up until 1975, of both import and export containers. Import containers were transferred from the ship to ITV's and then into the stacking area for positioning by the gantry cranes. Similarly, export containers were presented into the stacks from rail and road. The operational problems involved in servicing ships and simultaneously receiving and dispatching containers were severe and with increasing volumes of cargo and social pressures to abandon the road haulage of containers, it was decided to institute a major change in the operational organisation of the terminal.

From December 1974 all import containers except over-dimension and hazardous cargo containers were block-stacked on Number 4 Berth adjacent to the rail line and railed directly to a newly established 'decentralised container park' within the existing Chullora depot (see below). Export containers were delivered from Chullora into a pre-planned stacking pattern within the five-high stacking area. Empty export containers were stacked in areas at the eastern end of the terminal (Figures 3.3 and 3.4).

The limited terminal area also resulted in modifications of operational organisation as was the case at the Glebe Island terminal. In particular, control of road vehicles for the efficient management of container inventory and stacks was of particular importance: stack run-downs, stack build-ups and a vehicle time slotting system were used to achieve better receival and despatch operations (Seatainer Terminals Limited 1977).

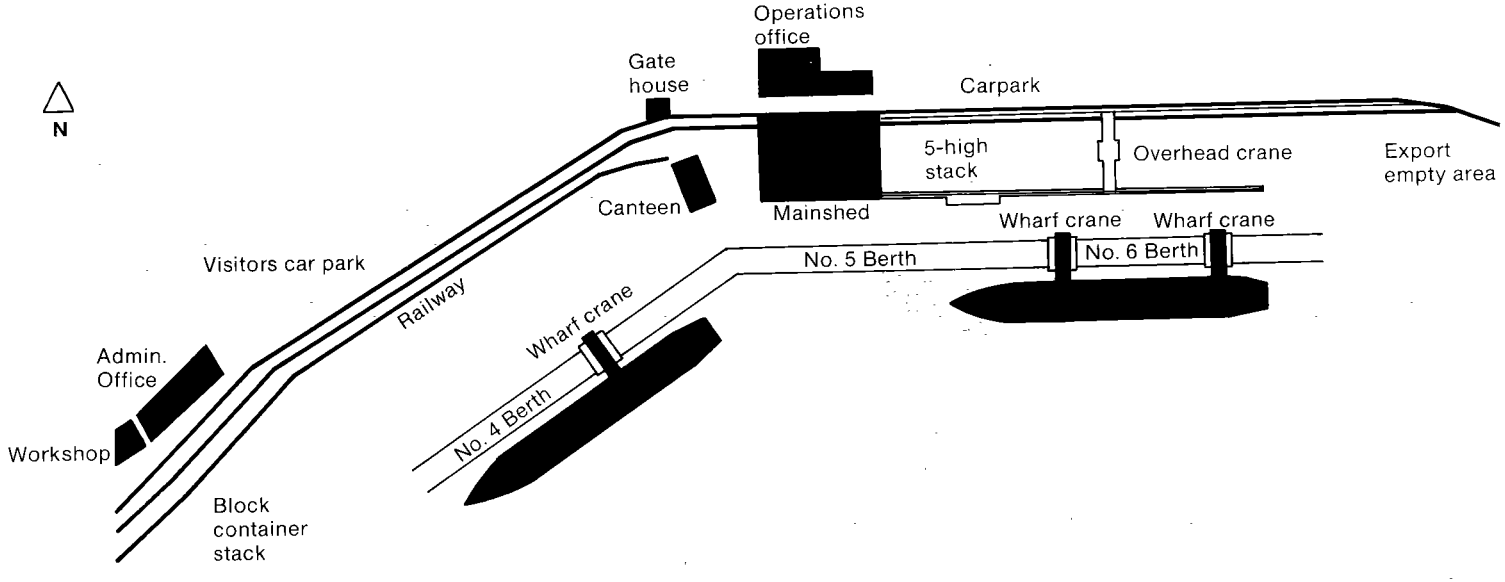


Figure 3.3—Layout of the Seatainer terminal at White Bay

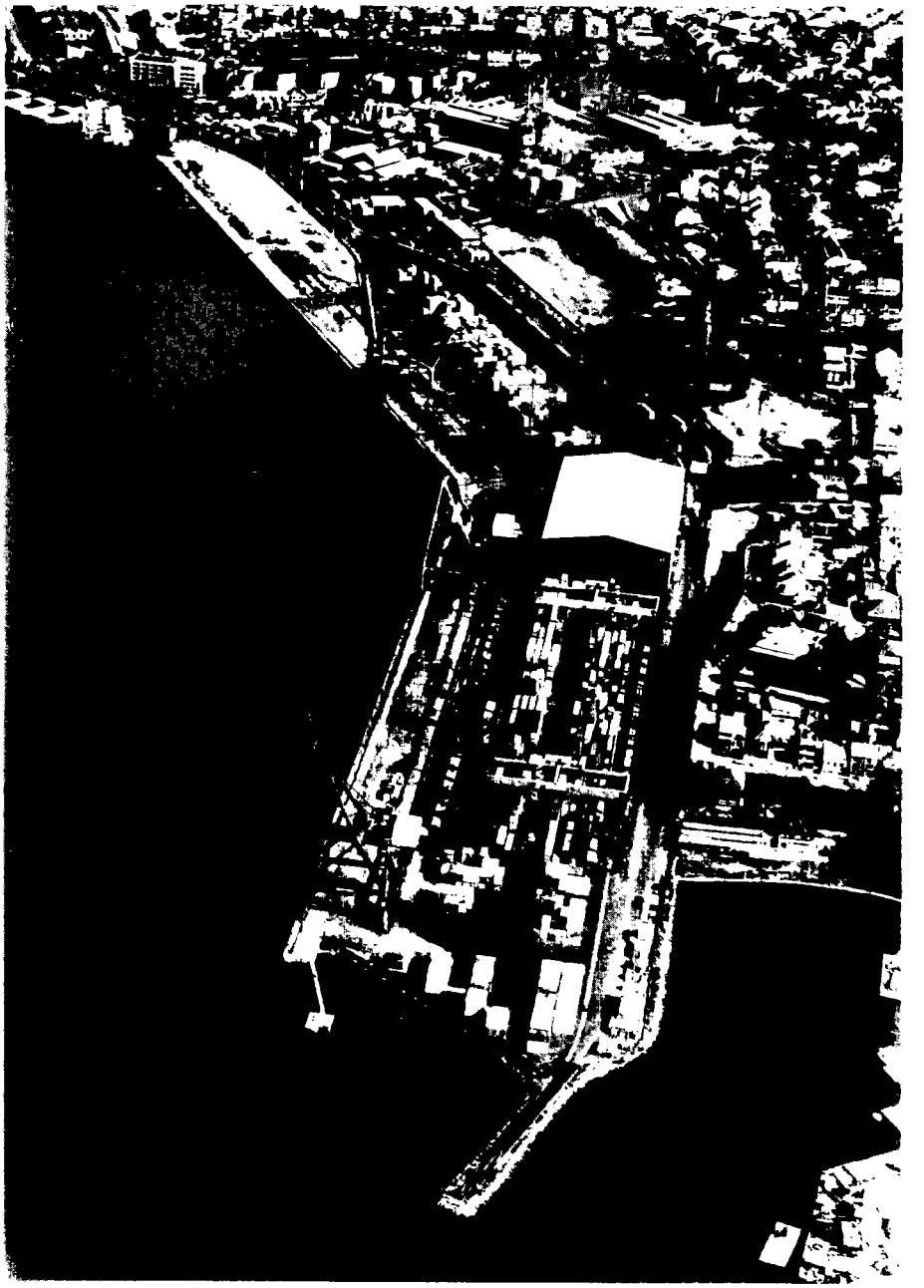


Figure 3.4—Seatainer terminal, White Bay (photography courtesy of Aerovision Photography, Sydney).

It was the development of the Chullora depot however, which enabled the terminal to achieve significantly greater efficiency. The depot began operations at the 19 hectare Chullora site in 1969 along with the commencement of operations at the Seatainer terminal. Initially the depot was designed to enable efficient handling of LCL cargo, together with other functions such as the operation of a bond store, the storage of empty containers and container repair and cleaning. By July 1975 3.2 hectares of the site had been paved for use as a 'decentralised container park' and all import containers were being railed by 'unit trains' direct to the depot (30 containers per train and up to 10 trains per day in peak periods).

Figure 3.5 shows the layout of the depot as it existed over the 1977 to 1981 period. The main shed (15 000 square metres) was used as a central facility for the packing and unpacking of LCL containers and utilised a 35 tonne three-high stacking crane for the movement of containers from packing areas to rail wagons and trucks. Containers were loaded to and from rail by heavy fork lifts with full containers (FCL) stacked for immediate delivery. Yard storage capacity exceeded 1100 containers in a two-high stacking configuration with provisions for the storage of empty containers. Depot throughputs varied over the period of operation, generally exceeding 100 000 containers per year, with an annual average of 118 000 containers in the four-year period 1975 to 1978 (McSporran 1978).

The two purpose-built container terminals in Port Jackson, together occupying only 20.6 hectares of prime waterfront land, clearly had few layout and operational characteristics in common other than size. The following sections explore characteristics of ship and container traffic for the two terminals.

VESSEL SIZE DISTRIBUTIONS

Not only were there basic differences in the layout of the two terminals, but there were also fundamental contrasts in the distributions of the sizes of vessels using the terminals. Quite simply, the Seatainer terminal serviced a substantially higher proportion of large vessels than did its Glebe Island counterpart. For the three sample years (1977, 1979 and 1981), almost 80 per cent of vessels using the Seatainer terminal were between 16 000 and 35 000 DWT (compared with 51 per cent for Glebe Island) and the proportion of vessels less than 20 000 DWT was only half that for the Glebe Island terminal (refer Table 3.2). The distributions of vessel sizes for vessel calls at each terminal are shown in Figure 3.6. The reasons for the differences in vessel size distributions are examined in the following sections.

Seatainer terminal

At the Seatainer terminal over the aggregate period one vessel in four was between 26–30 000 DWT and one in five was between 31–35 000 DWT. These two size classes contained a relatively large number of first and second generation container vessels employed by the two consortia which operate the Australia-United Kingdom-Europe conference services and which have been important throughout the whole period of Australian containerisation (Bureau of Transport Economics 1982).

In 1977 the 26–30 000 DWT class was the modal class, representing 27 per cent of all vessel calls at the terminal (Table 3.2). It included calls by six OCL Bay class vessels and five ACTA/ANL vessels. The 31–35 000 DWT class, comprising 18 per cent of vessel calls, was represented by four vessels in the integrated OCL service to Europe and by one of the remaining two vessels in the ACTA consortium.

By 1979 there had been some important changes. Four large vessels, all of about 39 000 DWT, had been added by the consortia operating on the Australia-United Kingdom-Europe routes and most of the vessels of less than 10 000 DWT (operated by the Zim Line) no longer called at the terminal.

The 1981 data reflect the significant impact which the opening of the ANL terminal at Botany Bay had on the number of vessel calls at the Seatainer terminal. The

TABLE 3.2—DISTRIBUTIONS OF VESSEL SIZES FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

Vessel size (thousand DWT)	GIT								STL							
	1977		1979		1981		1977, 1979 and 1981[a]		1977		1979		1981		1977, 1979 and 1981[b]	
	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent
0–10	15	7.6	39	17.3	38	23.9	92	15.8	20	13.0	5	3.4	7	7.3	32	8.0
11–15	82	41.6	43	19.0	43	27.0	168	28.9	2	1.3	1	0.7	12	12.5	15	3.8
16–20	24	12.2	27	11.9	15	9.4	66	11.3	28	18.2	36	24.2	2	2.1	66	16.5
21–25	36	18.3	80	35.4	39	24.5	155	26.6	30	19.5	27	18.1	7	7.3	64	16.0
26–30	33	16.7	29	12.9	14	8.8	76	13.1	41	26.6	33	22.1	29	30.2	103	25.8
31–35	1	0.5	0	0.0	0	0.0	1	0.2	27	17.5	26	17.4	30	31.3	83	20.8
36–40	5	2.5	1	0.4	0	0.0	6	1.0	2	1.3	16	10.7	6	6.3	24	6.0
41–45	1	0.5	7	3.1	10	6.3	18	3.1	3	1.9	4	2.7	3	3.1	10	2.5
46–50	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	1	0.7	0	0.0	2	0.5
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

a. Average ship size 18 069 DWT; standard deviation 8430.
b. Average ship size 25 356 DWT; standard deviation 9182.

Sources: Records of Glebe Island and Seatainer terminals.

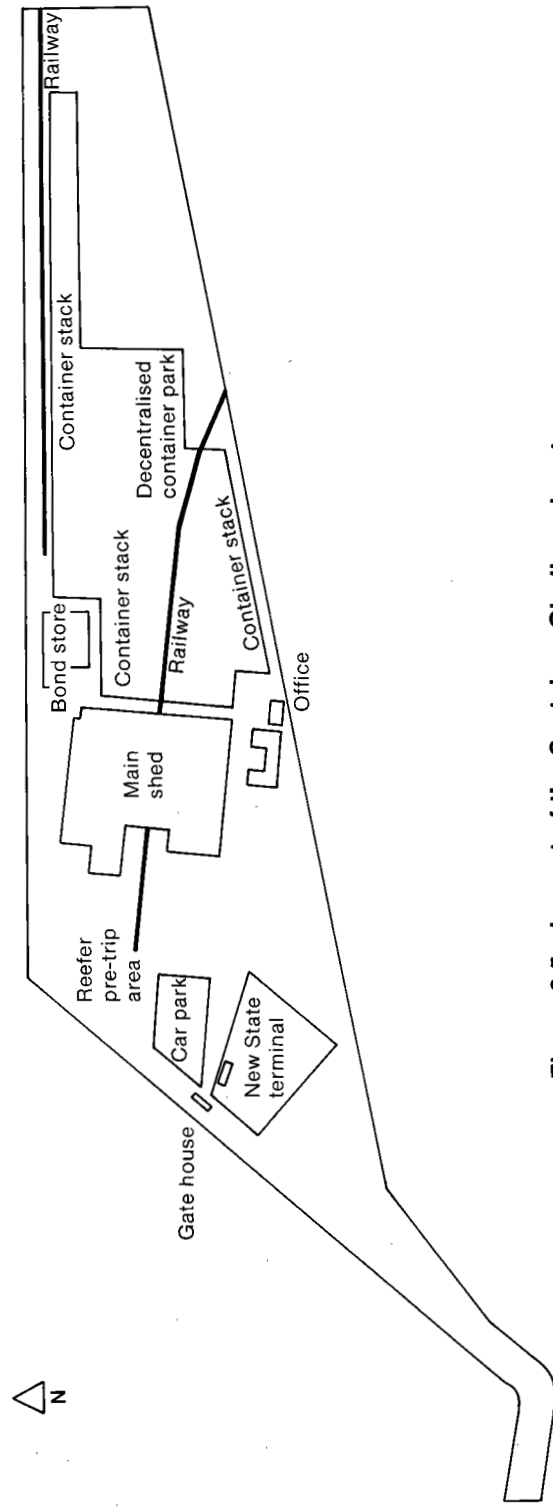


Figure 3.5—Layout of the Seatainer Chullora depot

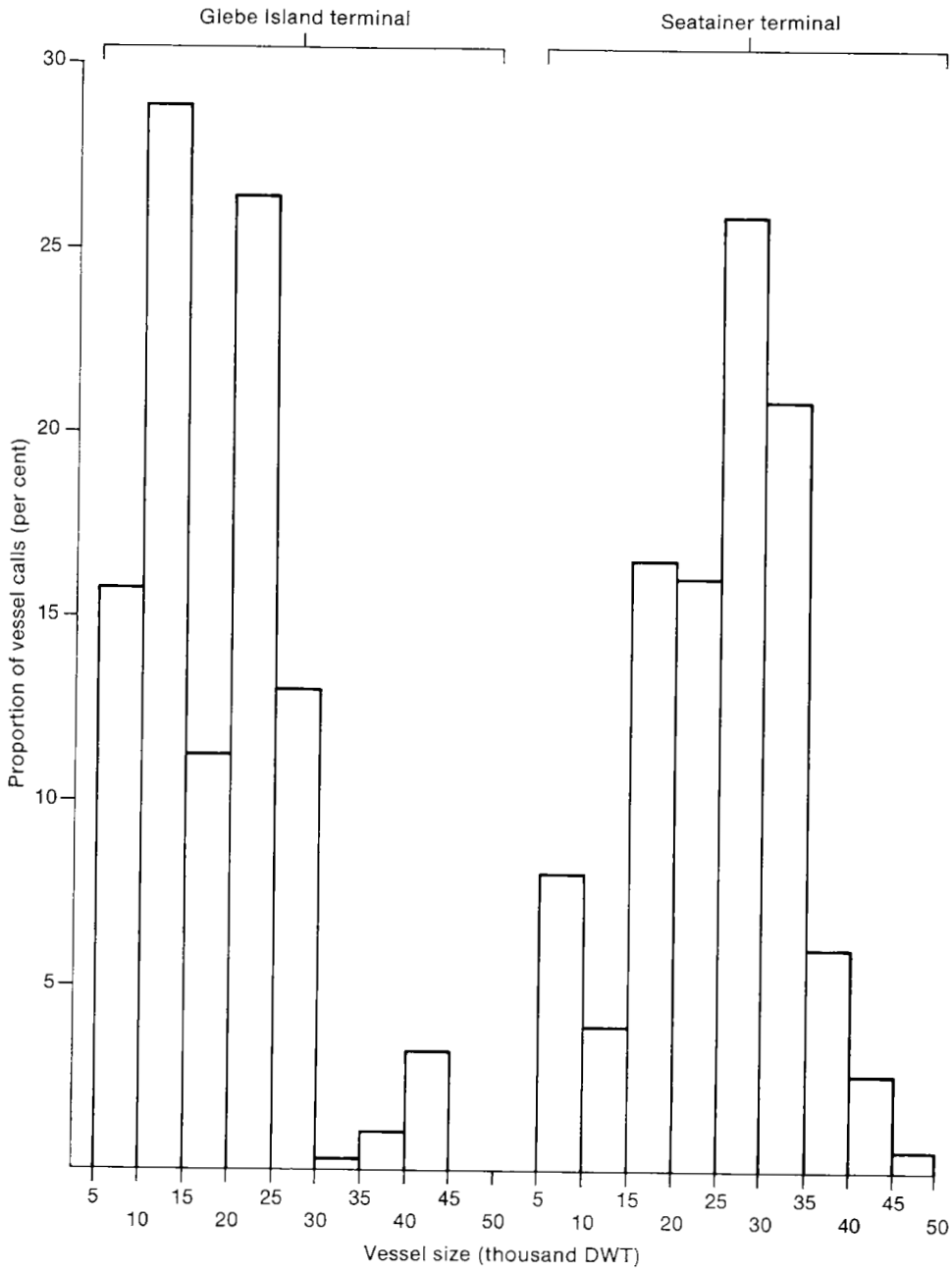


Figure 3.6—Vessel size distributions for the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

ACTA/ANL consortium switched its North American east-coast services and its Australia-United Kingdom-Europe services from the Port Jackson terminals to Botany Bay. The Eastern Searoad service to Japan and the Australian National Line Roll-on Roll-off (ANRO) service to south-east Asia also moved to the new terminal. The drop in the total number of vessel calls to 96, 62 per cent of the 1977 total, also reflects the progressive reduction in trade which was resulting from the more general, global economic downturn.

Glebe Island terminal

As a common user terminal Glebe Island was obliged to service any vessel on demand. Thus

> 'ships serviced range from the latest generation of specialised container ships to converted general purpose cargo vessels of indeterminate age. They included ships without cells and ships with a mixture of cargoes, ships with self-loading gear, LASH[1] ships and bulk carriers, ships of every size and configuration large and small, old and new' (Glebe Island Terminals Pty Ltd 1976).

In practice, although the terminal serviced a random group of vessels which differed greatly in size and efficiency, it also provided services on a regular basis for a group of shipping lines. Size distributions for Glebe Island reflected to a large extent the size structure of the fleets of these lines.

The 1977 vessel size distribution for Glebe Island (Table 3.2) shows the dominance in that year of the 11-15 000 DWT class with 42 per cent of total vessel calls. The preponderance of vessels in the 11-15 000 DWT class reflects vessel sizes in the fleets of the Columbus, Far Eastern Shipping Company (FESCO), Orient Overseas Container Line (OOCL) and Australia West Pacific Line (AWPL) groups. (Visits by vessels of the Columbus line, a shareholder in the Glebe Island terminal, made up a large proportion of total vessel calls at the terminal over the aggregate period).

A number of changes had taken place by 1979. The modal class had become the 21-25 000 DWT class, with 35 per cent of the total number of vessel calls, due to calls by the larger Columbus line vessels and vessels of the ABC Containerline and the Asia Australia Express Service.

The switch of Zim line vessels from the Seatainer terminal to Glebe Island boosted the proportion of vessels of less than 10 000 DWT from 8 per cent in 1977 to 17 per cent in 1979.

By 1981, the Glebe Island terminal, like its Seatainer counterpart, had felt the effects of the opening of the ANL terminal at Botany Bay as well as the general downturn in economic growth. It lost the ACTA/ANL North American Pacific America Container Express (PACE) service and the OOCL service, although it was not until November 1982 that Glebe Island lost the Zim line service to the ANL terminal at Botany Bay. The total number of vessels calls in 1981 was only 70 per cent of that in the peak year of 1979, with a general downward movement of vessel numbers into the smaller size groups. Fifty-one per cent of calls were by vessels of less than 15 000 DWT although there were more calls by vessels over 30 000 DWT than in the other two years of the sample period.

CONTAINER TRAFFIC

Table 3.3 lists the parameters of the container traffic handled in the three sample years for each individual terminal and for both terminals together. Clearly, care needs to be exercised in interpreting data from mean or average values, but the figures reveal some of the basic characteristics of the container flows.

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1. Lighter-aboard-ship. See Appendix I.

TABLE 3.3—PARAMETERS OF CONTAINER TRAFFIC FLOWS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(Number of containers per ship call)

	GIT		STL		GIT and STL	
Container traffic	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*
Import						
20' full	168	112	346	195	240	175
20' empty	14	49	15	61	15	54
40' full	45	54	56	57	49	52
40' empty	3	15	3	18	3	17
Reefer	na	na	8	9	na	na
Over-dimension	na	na	11	11	na	na
Total imports	230	145	439	236	307	205
Export						
20' full	96	71	152	120	119	3
20' empty	38	60	88	122	58	94
40' full	15	30	26	34	19	32
40' empty	34	57	29	43	32	52
Reefer	na	na	33	28	na	na
Over-dimension	na	na	1	2	na	na
Total exports	183	123	329	187	228	159
Total imports and exports	413	230	768	384	535	331
Restows	13	26	17	29	14	27
Total	426	na	785	na	549	na

sd standard deviation
na not available
Note: Sample sizes were 582 vessel calls for GIT and 399 vessel calls for STL. Total figures for GIT do not include reefer and over-dimension containers.

Sources: Records of Glebe Island and Seatainer terminals.

At the most general level, the 'average' ship which used either of the two Port Jackson terminals over the three-year period handled a total load (import and export containers expressed in TEUs) of 535, though the figure varied by about 62 per cent. There was a large difference, however, between the ship loads at the two terminals with ships at the Glebe Island terminal handling about 413 containers per ship, 54 per cent of the size of the average load (768 containers) handled by ships using the Seatainer terminal.

Of these totals, import containers (an average of 307 per ship) made up 57 per cent of the 'average' ship's load, a figure which was almost identical for ships using either terminal and which underlies the container flow imbalance in the Sydney trades. The preponderance of 20 foot containers in the Australian trades generally (particularly in the import flows) is evident from the table; 80 per cent of the total flow at both terminals was in 20 foot containers. The imbalance of import and export loads is consistent with the fact that Sydney is a net container importing port, as noted in Chapter 2.

Two further points are worth noting. Firstly, for both imports and exports, ships which used the Glebe Island terminal were characterised by greater proportionate load variability than those which used the Seatainer terminal; for imports the standard deviation was 63 per cent of the mean compared to 54 per cent and for exports 68 per cent compared to 57 per cent. This greater homogeneity of loads for vessels

using the Seatainer terminal reflects the vessel size distributions and trade patterns noted earlier. Secondly, the relatively high proportion of empty containers in Sydney's export flows (between 12 and 18 per cent for the port as a whole) are clearly evident from the figures. (It should be noted, however, that the mean values are inadequate indicators of the distributions, given the relatively high values of the standard deviations.)

Table 3.4 shows the distributions of the number of containers handled per vessel call at each of the two terminals over the aggregate period. For ease of comparison the distributions for each terminal are plotted in Figure 3.7.
Tables 3.5 and 3.6 show the component distributions for import and export flows respectively. These tables clearly show the basic contrasts in the size of vessel container loads between the two terminals. Again, it is clear that the 'average' value for the terminals considered together hide fundamental differences between the two. Thus for total exports and imports (Table 3.4) 55 per cent of ship calls involved the transfer of less than 500 containers, but in fact significantly smaller loads were characteristic of vessels using Glebe Island; 71 per cent of vessels handled a total of less than 500 containers compared with only 31 per cent of vessels using the Seatainer terminal. Larger loads, of more than 1000 containers, were handled by only 2 per cent of vessels over the three years at Glebe Island terminal, compared with 31 per cent at the Seatainer terminal.

In aggregate terms almost half the ships (47 per cent) which used the terminals handled less than 250 import containers (Table 3.5). But, in fact, only 25 per cent of the vessels using the Seatainer terminal had less than 250 containers, though 62 per cent of vessels at the Glebe Island terminal had less than this number; and again, while only 5 per cent of Glebe Island ships handled more than 500 import containers, over 40 per cent of vessels using the Seatainer terminal handled such loads. Table 3.5 further indicates that almost two-thirds of the vessels using the Seatainer terminal handled between 250 and 750 import containers.

Export totals (Table 3.6) show similar disparities between the two terminals with three-quarters of the vessels using the Glebe Island terminal handling less than 250 export containers.

The aggregate values for the terminals for 1977, 1979 and 1981 do not, of course, show changes over the sample period, but some indication of such changes can be gathered from values of the container traffic parameters for each of the three years for the individual terminals (Table 3.7).

Generally, the average load size for vessels (the total number of export and import containers handled) increased over the period, for Glebe Island from 338 in 1977 to 464 in 1981, and for the Seatainer terminal from 755 to 825. Interestingly, the variation from the mean remained almost constant; for Glebe Island the standard deviation was between 53 and 54 per cent of the mean in each of the three years and for the Seatainer terminal between 48 and 52 per cent. The average size of both import and export loads also increased over time.

DISCUSSION

Quite different technical and operational solutions were devised to overcome the fundamental constraints imposed by the small land area available for each terminal. Different types of equipment were installed, different stack layouts were used and different operational practices were developed. Moreover there was a definite emphasis towards road transport at Glebe Island terminal whereas the emphasis at the Seatainer terminal was towards rail transport.

Apart from these physical and operational differences between the terminals there were also significant differences in the type and size of the vessels and the number of containers handled per vessel. The Seatainer terminal was the conference server. The main source of demand for this terminal was the vessels sailing regular schedules

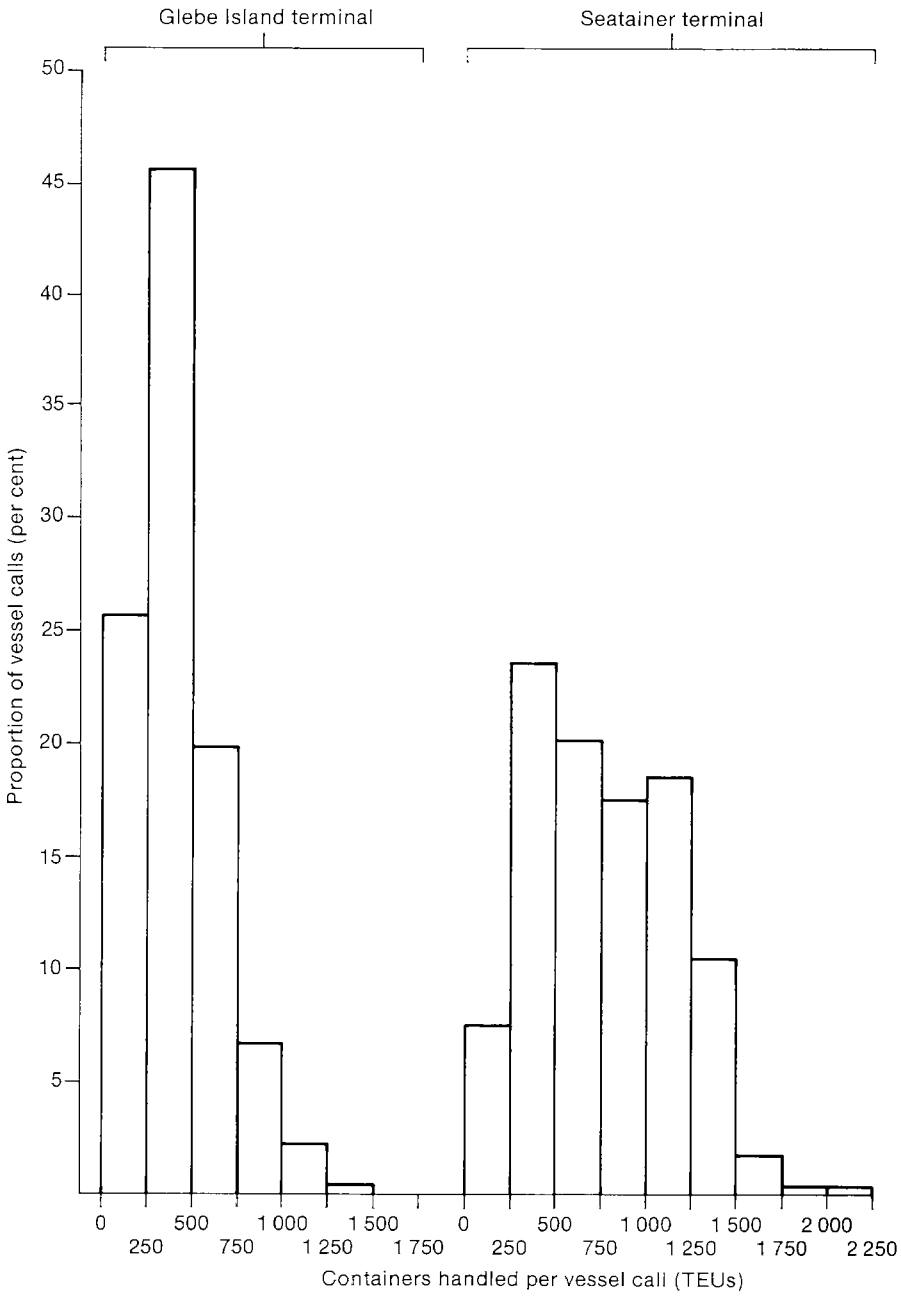

Figure 3.7—Distributions of the number of containers handled per vessel call for the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

TABLE 3.4—DISTRIBUTIONS OF THE NUMBER OF CONTAINERS HANDLED PER VESSEL CALL AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT			*STL*			*GIT and STL*		
Number of containers	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*
0- 250	149	25.6	25.6	30	7.5	7.5	179	18.2	18.2
251- 500	266	45.7	71.3	94	23.6	31.1	360	36.7	54.9
501- 750	115	19.8	91.1	80	20.1	51.2	195	19.9	74.8
751-1000	38	6.5	97.6	70	17.5	68.7	108	11.0	85.8
1001-1250	12	2.1	99.7	74	18.5	87.2	86	8.8	94.6
1251-1500	2	0.3	100.0	42	10.5	97.7	44	4.5	99.1
1501-1750	0	0.0	100.0	7	1.8	99.5	7	0.7	99.8
1751-2000	0	0.0	100.0	1	0.3	99.7	1	0.1	99.9
2001-2250	0	0.0	100.0	1	0.3	100.0	1	0.1	100.0
Total	582	100.0		399	100.0		981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 3.5—DISTRIBUTIONS OF THE NUMBER OF IMPORT CONTAINERS HANDLED PER VESSEL CALL AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT			*STL*			*GIT and STL*		
Number of containers	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*
0- 250	362	62.2	62.2	100	25.1	25.1	462	47.1	47.1
251- 500	192	33.0	95.2	128	32.1	57.2	320	32.6	79.7
501- 750	25	4.3	99.5	129	32.3	89.5	154	15.7	95.4
751-1000	2	0.3	99.8	40	10.0	99.5	42	4.3	99.7
1001-1250	1	0.2	100.0	2	0.5	100.0	3	0.3	100.0
Total	582	100.0		399	100.0		981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 3.6—DISTRIBUTIONS OF THE NUMBER OF EXPORT CONTAINERS HANDLED PER VESSEL CALL AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT			*STL*			*GIT and STL*		
Number of containers	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*	*Ship calls*	*per cent*	*Cumulative per cent*
0– 250	446	76.6	76.6	159	39.8	39.8	605	61.7	61.7
251– 500	123	21.1	97.7	169	42.4	82.2	292	29.8	91.5
501– 750	12	2.1	99.8	64	16.0	98.2	76	7.7	99.2
751–1000	1	0.2	100.0	7	1.8	100.0	8	0.8	100.0
Total	582	100.0		399	100.0		981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 3.7—PARAMETERS OF CONTAINER TRAFFIC FLOWS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

(Number of containers per ship call)

	GIT						*STL*					
	1977		*1979*		*1981*		*1977*		*1979*		*1981*	
Container type	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*
Import												
20' full	157	107	159	112	193	116	349	196	334	181	359	216
20' empty	9	26	21	60	11	51	12	70	16	42	19	71
40' full	23	28	53	63	59	59	49	49	53	42	74	49
40' empty	1	9	6	22	1	9	4	18	3	21	2	13
Reefer	na	na	na	na	na	na	6	8	8	9	9	7
Over-dimension	na	na	na	na	na	na	8	9	10	10	17	15
Total imports	190	121	240	151	264	155	428	235	424	210	479	280
Export												
20' full	102	68	97	68	87	77	159	123	155	131	137	96
20' empty	23	50	40	54	53	74	79	102	79	125	115	141
40' full	13	25	12	18	22	45	22	32	24	30	36	40
40' empty	10	20	51	69	38	59	32	38	25	51	31	36
Reefer	na	na	na	na	na	na	35	31	35	28	26	21
Over-dimension	na	na	na	na	na	na	1	2	1	2	1	1
Total exports	147	94	199	127	200	140	327	184	318	194	346	185
Total imports and exports	338	182	439	239	464	246	755	390	733	355	825	415
Restows	12	24	12	22	14	31	12	23	18	32	23	33
Total	350	na	451	na	480	na	767	na	752	na	848	na

sd standard deviation
na not available

Note: Figures may not add to totals due to rounding. Total figures for GIT do not include reefer and over-dimension containers.

Sources: Records of Glebe Island and Seatainer terminals.

on the Australia-Europe and Australia-Japan trades. The vessels which berthed at the Seatainer terminal were on average larger and carried larger loads than the vessels which used Glebe Island. The Glebe Island terminal was, and still is, a typical common user terminal. It serviced more vessels that the Seatainer terminal and there was less homogeneity in the traffic stream with services to and from Asia and the East and West Coasts of North America.

The scene is now set to examine the effect that these contrasts had on ship and terminal productivities.

CHAPTER 4—VESSEL TIMES AND CONTAINER HANDLING RATES

This chapter analyses the components of container ship port time in order to identify in particular the time actually spent transferring containers on and off vessels. Measures of terminal productivity are derived from the various components of the port time and the values for each terminal are compared.

The relationship between the various port time components and the derived productivity measures (container handling rates) are shown diagramatically in Figure 4.1. Corresponding definitions are given in Table 4.1.

TABLE 4.1—DEFINITIONS OF VESSEL TIMES AND CONTAINER HANDLING RATES

Measure	*Definition*
Vessel times	
Port time	Time between vessel arrival and departure from port
Alongside time	Time between vessel arrival and departure from berth
Time labour available to ship[a]	Time between labour first going aboard and going ashore with all work completed
Non-operational delay time	Delay time caused by such factors as industrial disputes, unfavourable weather conditions, ship equipment breakdown
Time available for working cargo	Time labour available to ship less non-operational delay time
Container exchange time	Time available for working cargo less time spent lashing and unlashing containers on board less other delays which affected the exchange of containers
Container handling rates	Number of TEUs handled per ship per hour of
Alongside handling rate	alongside time
Container working rate	Number of TEUs handled per ship per hour of time available for working cargo
Net container working rate	Number of TEUs handled per ship per hour of container exchange time

a. Also known as gross working time in Maritime Services Board records.

VESSEL TIMES

Port time

The total time which container vessels spent in port (the difference between arrival date and time and departure date and time) was available for all 594 vessel calls to the Glebe Island and Seatainer terminals over the three-year period. Tables 4.2 and 4.3 show the parameters of the port time distributions for the Glebe Island and

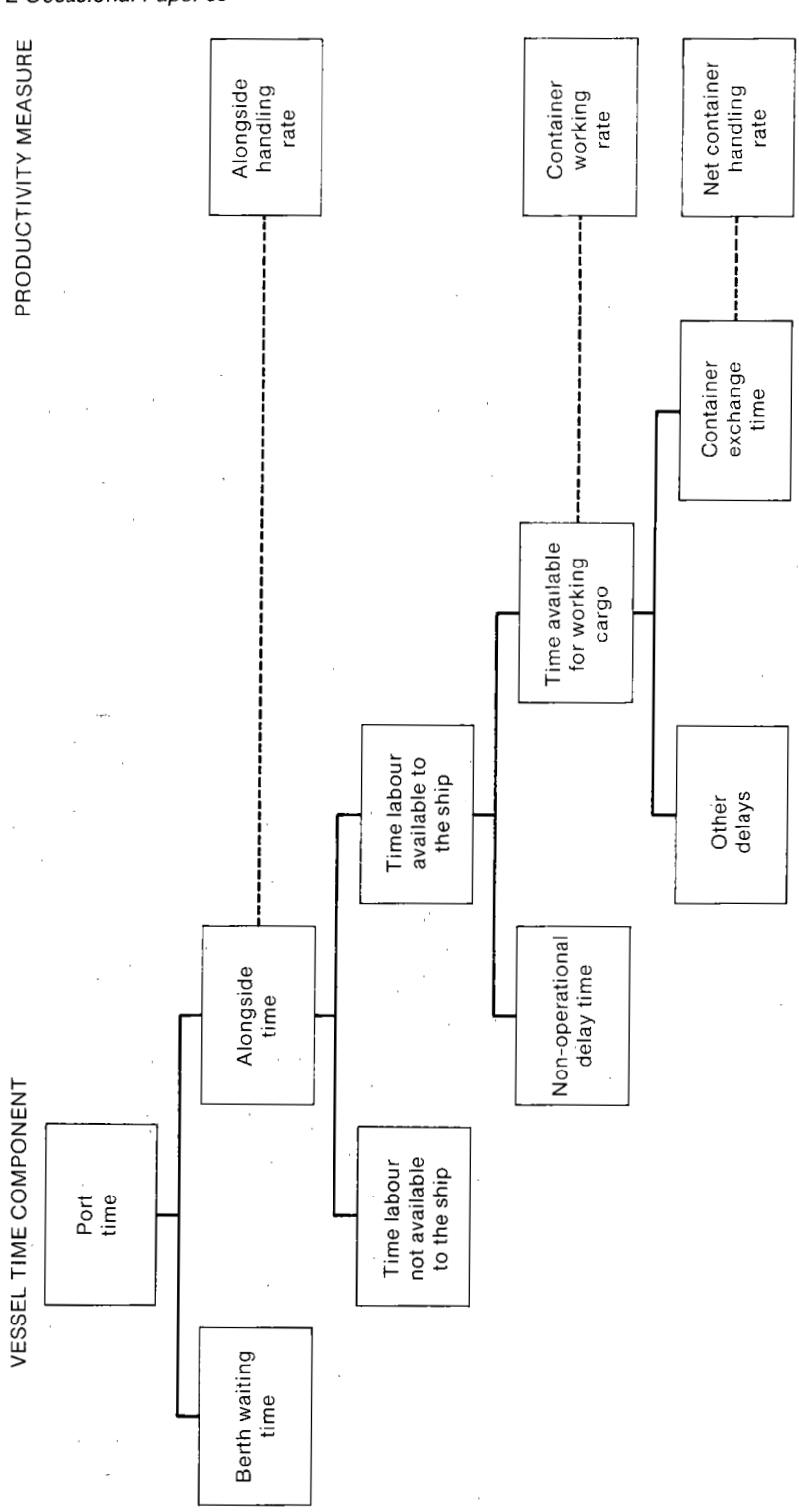

Figure 4.1—Components of vessel time and related productivity measures

Seatainer terminals respectively. In each year port times for calls to the Seatainer terminal were considerably longer on average than for calls to the Glebe Island terminal. The difference between the mean port times over the aggregate period (79 hours for Glebe Island terminal and 105 hours for the Seatainer terminal) reflects this situation.

TABLE 4.2—PARAMETERS OF PORT TIME FOR VESSEL CALLS AT THE GLEBE ISLAND TERMINAL; 1977, 1979 AND 1981

(Hours per ship call)

Measure	*1977*	*1979*	*1981*	*1977, 1979 and 1981*
Mean	56.0	99.0	81.0	79.4
Standard deviation	40.4	81.1	52.7	64.5
Median	45.6	76.8	70.8	61.3
Mode	28.5	44.5	44.5	28.5
Maximum	259.1	508.0	345.5	508.0

Note: Sample sizes were: 1977, 200 vessel calls; 1979, 226 vessel calls; 1981, 169 vessel calls; aggregate period, 595 vessel calls.

Source: Maritime Services Board records.

TABLE 4.3—PARAMETERS OF PORT TIME FOR VESSEL CALLS AT THE SEATAINER TERMINAL; 1977, 1979 AND 1981

(Hours per ship call)

Measure	*1977*	*1979*	*1981*	*1977, 1979 and 1981*
Mean	86.4	117.3	116.9	105.3
Standard deviation	67.1	87.0	133.1	94.9
Median	72.6	97.6	87.8	81.5
Mode	76.0	50.3	54.0	50.3
Maximum	496.0	667.0	865.0	865.0

Note: Sample sizes were: 1977, 154 vessel calls; 1979, 149 vessel calls; 1981, 96 vessel calls; aggregate period, 339 vessel calls.

Source: Seatainer terminal records.

The distribution of port time for the aggregate period for each terminal is shown in Table 4.4 (Glebe Island terminal) and Table 4.5 (Seatainer terminal). The generally longer port times for ship calls at the Seatainer terminal are apparent from these tables. For example, port times of less than 48 hours were recorded for 19 per cent of calls at the Seatainer terminal and 38 per cent of calls at the Glebe Island terminal. Furthermore a greater proportion of calls at the Seatainer terminal had very long port times (greater than 160 hours) than at the Glebe Island terminal. About 50 per cent of calls to the Seatainer terminal had port times greater than 72 hours whereas the median value for the Glebe Island terminal was 62 hours.

Alongside time

The time which a vessel spent beside the berth, from the time it was made fast until the time its lines were cast ashore, is defined here as the alongside time. The 'average' vessel during the three-year sample period 1977, 1979 and 1981 spent 70 hours or almost three days at berth (Table 4.6), although vessels which used the Glebe Island terminal were at berth for much less than this average (54 hours) and considerably less than vessels at the Seatainer terminal (94 hours or almost 4 days).

TABLE 4.4—DISTRIBUTION OF PORT TIME PER VESSEL CALL FOR THE GLEBE ISLAND TERMINAL; AGGREGATED OVER 1977, 1979 AND 1981

Port time (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 8	2	0.3	0.3
9- 16	12	2.0	2.4
17- 24	31	5.2	7.6
25- 32	69	11.6	19.2
33- 40	55	9.2	28.4
41- 48	62	10.4	38.8
49- 56	40	6.7	45.5
57- 64	40	6.7	52.3
65- 72	36	6.1	58.3
73- 80	29	4.9	63.2
81- 88	32	5.4	68.6
89- 96	26	4.4	72.9
97-104	19	3.2	76.1
105-112	20	3.4	79.5
113-120	13	2.2	81.7
121-128	13	2.2	83.9
129-136	15	2.5	86.4
137-144	14	2.4	88.7
145-152	9	1.5	90.3
153-160	10	1.7	91.9
>160	48	8.1	100.0
Total	595	100.0	

Source: Maritime Services Board records.

The general characteristics of the distribution of alongside times for ship calls at both terminals over the three sample years are given in Table 4.7, which shows frequencies for eight-hour time intervals, more-or-less equivalent to the three-shift breakdown of the 24-hour day. Although there is an apparent attenuation of the alongside time profile, 61 per cent of ships spent between one and three days at berth and 85 per cent spent less than four days. Almost 10 per cent of vessels remained for no longer than one day at berth and 6 per cent of vessels in the three-year period stayed for more than six days. (In odd cases, vessels were 'caught' for lengthy periods by industrial unrest, the most extreme example being a ship tied up in December 1981 and January 1982 for over one month) Table 4.8 shows the pattern of alongside times for each terminal separately, in 24-hour time intervals and over the three years. The shorter alongside times at the Glebe Island terminal are apparent. For the three years taken together, 84 per cent of ships cleared the terminal in less than three days and 94 per cent in less than four days, compared with 53 per cent and 72 per cent respectively for the Seatainer terminal. Only 2 per cent of vessels in three years remained at a Glebe Island berth for more than six days compared with 12 per cent at the Seatainer terminal.

Some changes over time were also apparent at the terminals. At the Glebe Island terminal for example, with increasing vessel size and loads carried over the period, the proportion of vessel calls of less than 24 hours at berth decreased significantly from 21 per cent in 1977 to 7 per cent in 1981. Conversely the proportion of vessels spending between three and four days increased from 4 per cent of vessels in 1977 to 16 per cent in 1981. More vessels also stayed longer than four days, although the number remained relatively small, from 3 per cent in 1977 to 7 per cent in 1981. Similarly, at the Seatainer terminal, fewer ships spent between one and two days at the terminal, with the proportion declining from 21 per cent in 1977 to 12 per

TABLE 4.5—DISTRIBUTION OF PORT TIME PER VESSEL CALL FOR THE SEATAINER TERMINAL; AGGREGATED OVER 1977, 1979 AND 1981

Port time (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0– 8	6	1.5	1.5
9– 16	5	1.3	2.8
17– 24	7	1.8	4.5
25– 32	12	3.0	7.5
33– 40	19	4.8	12.3
41– 48	27	6.8	19.0
49– 56	21	5.3	24.3
57– 64	64	16.0	40.4
65– 72	32	8.0	48.4
73– 80	27	6.8	55.1
81– 88	16	4.0	59.1
89– 96	23	5.8	64.9
97–104	18	4.5	69.4
105–112	11	2.8	72.2
113–120	13	3.3	75.4
121–128	8	2.0	77.4
129–136	11	2.8	80.2
137–144	7	1.8	82.0
145–152	9	2.3	84.2
153–160	8	2.0	86.2
> 160	55	13.8	100.0
Total	399	100.0	

Source: Seatainer terminal records.

TABLE 4.6—PARAMETERS OF ALONGSIDE TIME FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(Hours per ship call)

Measure	*GIT*	*STL*	*GIT and STL*
Mean	54.2	94.0	70.4
Standard deviation	41.7	80.5	63.6
Median	45.7	76.3	56.1
Mode	37.0	74.0	46.0
Maximum	384.0	863.0	863.0

Note: Sample sizes were: GIT, 582 vessel calls; STL, 399 vessel calls; total, 981 vessel calls.

Sources: Records of Glebe Island and Seatainer terminals.

cent in 1981, and more spent over five days at berth, the proportion varying from 9 per cent in 1977 to 23 per cent in 1979 and 18 per cent in 1981.

Table 4.9 shows the relationship between alongside time and port time for the Seatainer terminal and indicates the delays experienced by ships waiting to berth. The table shows that, for 84 per cent of the vessels using the Seatainer terminal, time alongside represented between 91 and 100 per cent of port time. For 8 per cent of vessels however, alongside time represented less than 50 per cent of port time. Comparative figures for other ports are not available although it would be interesting to know whether this proportion conforms to a 'normal' pattern.

TABLE 4.7—DISTRIBUTION OF ALONGSIDE TIME PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Alongside time (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0– 8	15	1.5	1.5
9– 16	21	2.1	3.7
17– 24	61	6.2	9.9
25– 32	83	8.5	18.3
33– 40	99	10.1	28.4
41– 48	110	11.2	39.7
49– 56	70	7.1	46.8
57– 64	169	17.2	64.0
65– 72	71	7.2	71.3
73– 80	57	5.8	77.1
81– 88	44	4.5	81.5
89– 96	33	3.4	84.9
97–104	28	2.9	87.8
105–112	15	1.5	89.3
113–120	18	1.8	91.1
121–128	11	1.1	92.3
129–136	10	1.0	93.3
137–144	6	0.6	93.9
145–152	9	0.9	94.8
153–160	5	0.5	95.3
> 160	46	4.7	100.0
Total	981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

Of the total time which a vessel spent alongside a berth, how much was spent in cargo handling and related operations? It was expected that the difference between alongside time and work time would be very small for cellular container vessels and an attempt was made in this study to assess this difference.

Alongside time was therefore further refined in an attempt to specify the relevant component times. Four components were examined:

- the length of time for which labour was available to the ship;
- the actual time available for working cargo;
- the container exchange time (the actual time consumed in the exchange of containers to and from the vessel, available for the Seatainer terminal only); and
- the non-operational delay times at the berth.

Each of these is discussed in more detail below.

Time labour available to the ship

The time during which labour was assigned to the ship, from the time labour went aboard until labour went ashore with all work completed, was known variously as 'operational time' (Glebe Island terminal) or 'gross working time' (Seatainer terminal). It is a gross index of the length of time taken by a vessel to complete its unloading and loading operations, although not all of this time was necessarily spent actually working cargo. The term 'labour available time' is used in this Paper.

Table 4.10 lists the parameters of labour available time for both terminals over all three years of the sample period. For all 981 vessel calls the mean labour available

TABLE 4.8—DISTRIBUTIONS OF ALONGSIDE TIME PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

Vessel size (thousand DWT)	GIT								STL							
	1977		1979		1981		1977, 1979 and 1981		1977		1979		1981		1977, 1979 and 1981	
	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent
0- 24	42	21.3	34	15.0	11	6.9	87	14.9	6	3.9	1	0.7	3	3.1	10	2.5
25- 48	85	43.2	77	34.1	62	39.0	224	38.5	33	21.4	24	16.1	11	11.5	68	17.0
49- 72	56	28.4	73	32.3	49	30.8	178	30.6	56	36.4	46	30.9	30	31.3	132	33.1
73- 96	8	4.1	24	10.6	26	16.4	58	10.0	29	18.8	25	16.8	22	22.9	76	19.1
97-120	3	1.5	6	2.7	4	2.5	13	2.2	17	11.0	18	12.1	13	13.5	48	12.0
121-144	0	0.0	3	1.3	5	3.1	8	1.4	4	2.6	12	8.0	3	3.1	19	4.8
> 144	3	1.5	9	4.0	2	1.3	14	2.4	9	5.9	23	15.4	14	14.6	46	11.5
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Source: Records of Glebe Island and Seatainer terminals.

TABLE 4.9—DISTRIBUTION OF THE PROPORTION THAT ALONGSIDE TIME WAS OF PORT TIME FOR VESSEL CALLS AT THE SEATAINER TERMINAL; AGGREGATED OVER 1977, 1979 AND 1981

Proportion (per cent)	*Ship calls*	*Per cent of total*	*Cumulative per cent*
0- 10	6	1.6	1.6
11- 20	1	0.3	1.9
21- 30	2	0.5	2.5
31- 40	9	2.5	4.9
41- 50	11	3.0	7.9
51- 60	4	1.1	9.0
61- 70	8	2.2	11.2
71- 80	4	1.1	12.3
81- 90	14	3.8	16.2
91-100	306	83.8	100.0
Total	365	100.0	

Source: Seatainer terminal records.

TABLE 4.10—PARAMETERS OF LABOUR AVAILABLE TIME FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(hours per ship call)

Measure	GIT	STL	GIT and STL
Mean	33.4	74.7	50.2
Standard deviation	23.1	56.9	45.2
Median	29.3	67.5	38.8
Mode	18.0	67.0	18.0
Maximum	234.0	858.0	858.0

Note: Sample sizes were: GIT, 582 vessel calls; STL, 399 vessel calls; total, 981 vessel calls.

Sources: Records of Glebe Island and Seatainer terminals.

time was 50 hours, with means for the individual terminals being 33 hours (Glebe Island terminal) and 75 hours (Seatainer terminal). If these values are compared with the average alongside time values in Table 4.5 to give a crude indicator of the relationship of labour available time to alongside time it is found that the proportion varies from 61 per cent for the Glebe Island terminal to 80 per cent for the Seatainer terminal with an average of 71 per cent.

The distribution of labour available time is shown in Tables 4.11 and 4.12. For all vessels over the three sample years 25 per cent had labour available for less than 24 hours and 60 per cent for 48 hours or less (Table 4.11). For 9 per cent of the vessels labour was available for 96 hours or more.

The differences in the magnitudes of labour available times between the two terminals is apparent from Table 4.12. For all three years for example, 82 per cent of vessel calls at the Glebe Island terminal had labour available times of 48 hours or less compared with 29 per cent for calls at the Seatainer terminal. Over the three sample years, the general pattern was for an increase in the time labour spent aboard, so that for the Glebe Island terminal there was a decline in the proportion of vessels with labour available for less than 24 hours from 49 per cent of calls in 1977 to 25 per cent in 1981. In the case of the Seatainer terminal, the comparative time class was 25-48 hours, which declined from 32 per cent in 1977 to 14 per cent in 1981.

TABLE 4.11—DISTRIBUTION OF LABOUR AVAILABLE PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Labour available time (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 8	43	4.4	4.4
9- 16	71	7.2	11.6
17- 24	127	12.9	24.6
25- 32	139	14.2	38.7
33- 40	124	12.6	51.4
41- 48	85	8.7	60.0
49- 56	55	5.6	65.6
57- 64	131	13.4	79.0
65- 72	40	4.1	83.1
73- 80	29	3.0	86.0
81- 88	26	2.7	88.7
89- 96	26	2.7	91.3
97-104	19	1.9	93.3
105-112	17	1.7	95.0
113-120	10	1.0	96.0
121-128	6	0.6	96.6
129-136	7	0.7	97.3
137-144	4	0.4	97.8
145-152	5	0.5	98.3
153-160	4	0.4	98.7
> 160	13	1.3	100.0
Total	981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

The relationship between labour available time and alongside time is shown in Table 4.13 and Figure 4.2, which reveal significant differences between the two terminals. At Glebe Island terminal, for 24 per cent of all vessel calls, labour available time represented over 90 per cent of alongside time and for 38 per cent of vessel calls, between 80 and 100 per cent. For more than a quarter of vessel calls labour available time represented less than 50 per cent of alongside time. The corresponding results for vessel calls at the Seatainer terminal were considerably higher with 63 per cent of vessel calls having labour available for over 90 per cent of alongside time and 76 per cent of calls having labour available for over 80 per cent of alongside time. There still remained however, 11 per cent of vessel calls for which labour available time was less than 50 per cent of alongside time.

Time available for working cargo

The time for which labour was available to the ship was an inaccurate measure of cargo working time and account needs to be taken of the non-operational delays to cargo working. For both terminals, a record was kept of these non-operational times. For Glebe Island terminal, the following nine delay causes were specified:

- waiting for cargo;
- ship delays, including, for example, delays caused by shipboard equipment problems;
- industrial disputes;
- power supply failures;
- weather problems: wind, rain, heat;

TABLE 4.12—DISTRIBUTIONS OF LABOUR AVAILABLE TIME PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

	GIT								*STL*							
Labour available time (hours)	*1977*		*1979*		*1981*		*1977, 1979 and 1981*		*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Ship calls	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0– 24	97	49.2	84	37.2	39	24.5	220	37.8	6	3.9	10	6.7	5	5.2	21	5.3
25– 48	76	38.7	99	43.8	80	50.3	255	43.8	49	31.8	31	20.8	13	13.6	93	23.3
49– 72	18	9.1	37	16.4	32	20.1	87	15.0	54	35.1	51	34.2	32	35.4	139	34.8
73– 96	4	2.0	3	1.3	5	3.2	12	2.1	26	16.9	21	14.1	22	22.9	69	17.3
97–120	1	0.5	0	0.0	2	1.3	3	0.5	14	9.1	20	13.5	9	9.4	43	10.8
121–144	0	0.0	2	0.9	1	0.6	3	0.5	3	1.9	6	4.0	5	5.2	14	3.5
> 144	1	0.5	1	0.4	0	0	2	0.3	2	1.3	10	6.7	8	8.3	20	5.0
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Sources: Records of Glebe Island and Seatainer terminals.

- waiting for crane booms to be raised at the direction of the MSB;
- labour off the ship;
- breakfast hour allocation; and
- 'other reasons'.

The list for the Seatainer terminal was similar in intent although the exact wording differed. Unfortunately the specific causes were not always clearly identified in the ship records although the total figure was accurate. Tables 4.14 to 4.17 summarise the findings.

The average time available for working cargo over the three sample years for all vessel calls in the sample was 39 hours. For vessel calls at Glebe Island terminal and the Seatainer terminal the average times were 28 and 56 hours respectively. What is more significant is the relationship of these averages with those for labour available time and alongside time. Again, in general terms, the average time available for working cargo per ship varied from 75 to 81 per cent of the average labour available time and represented between 51 and 60 per cent of the average alongside time per vessel.

The distribution of the time available for working cargo at both terminals over the aggregate period is shown in Table 4.15. Table 4.16 shows the distributions in individual years at each terminal.

Seventy per cent of all ships in the period had a cargo working time of not more than 48 hours (or six working shifts) and only 11 per cent had more than 64 hours, or eight shifts (Table 4.15). There were some significant differences between the two terminals (Table 4.16). Over the aggregate period (and for each year within the period) working times at Glebe Island terminal were shorter than at the Seatainer terminal. Thus, for the three years, 45 per cent of ship visits to the Glebe Island terminal had a cargo working time of less than 24 hours, whereas for the Seatainer terminal the corresponding proportion was only 8 per cent. Conversely less than 1 per cent of ship visits to Glebe Island had a cargo working time greater than 64 hours, while at the Seatainer terminal the corresponding figure was 26 per cent. Over the three-year period only two visits to the Glebe Island terminal had a cargo working time greater than 72 hours, compared with a corresponding figure of 73 visits at the Seatainer terminal.

TABLE 4.13—DISTRIBUTIONS OF LABOUR AVAILABLE TIME AS A PROPORTION OF ALONGSIDE TIME FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT		*STL*		*GIT and STL*	
Proportion (per cent)	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0- 10	21	4.0	7	1.9	28	3.1
11- 20	18	3.4	8	2.1	26	2.9
21- 30	30	5.7	7	1.9	37	4.1
31- 40	28	5.3	8	2.1	36	4.0
41- 50	44	8.3	10	2.7	54	6.0
51- 60	65	12.3	9	2.4	74	8.2
61- 70	61	11.6	16	4.3	77	8.5
71- 80	61	11.6	24	6.4	85	9.4
81- 90	72	13.6	50	13.4	122	13.5
91-100	128	24.2	235	62.8	363	40.2
Total	528	100.0	374	100.0	902	100.0

Sources: Records of Glebe Island and Seatainer terminals.

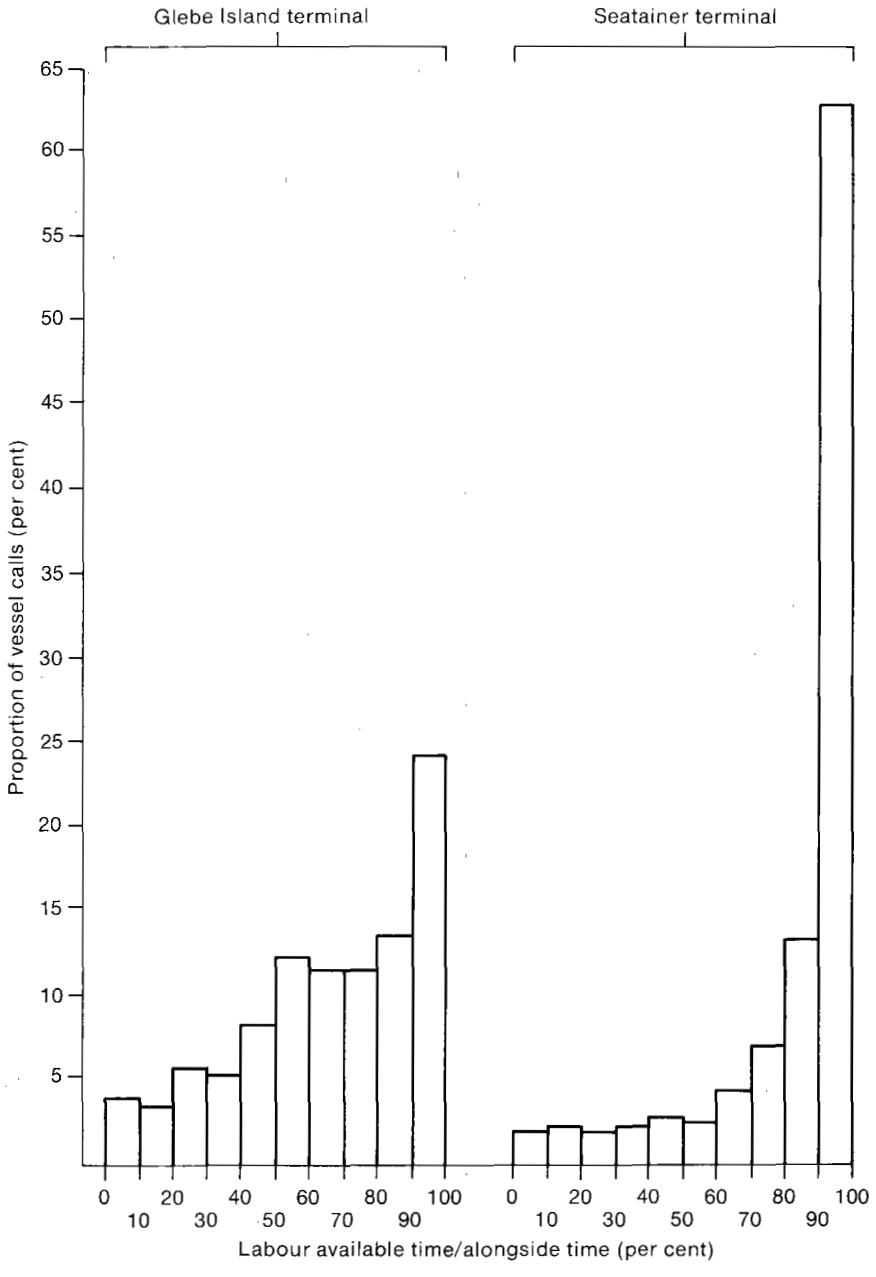

Figure 4.2—Distributions of the proportion that labour available time was of alongside time for vessel calls at the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

TABLE 4.14—PARAMETERS OF TIME AVAILABLE FOR WORKING CARGO FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(Hours per ship call)

Measure	*GIT*	*STL*	*GIT and STL*
Mean	27.5	56.2	39.2
Standard deviation	16.1	26.4	25.2
Median	25.9	54.0	34.1
Mode	20.5	60.5	20.5
Maximum	113.0	147.0	147.0

Note: Sample sizes were: GIT, 582 vessel calls; STL, 399 vessel calls; total, 981 vessel calls.

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.15—DISTRIBUTION OF TIME AVAILABLE FOR WORKING CARGO PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Time available (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 8	60	6.1	6.1
9-16	75	7.6	13.8
17-24	157	16.0	29.8
25-32	154	15.7	45.5
33-40	140	14.3	59.7
41-48	101	10.3	70.0
49-56	52	5.3	75.3
57-64	134	13.7	89.0
65-72	33	3.4	92.4
73-80	22	2.2	94.6
81-88	18	1.8	96.4
89-96	14	1.4	97.9
> 96	21	2.1	100.0
Total	981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

The relationship between time available for working cargo and alongside time is described in detail by the distributions listed in Table 4.17 and plotted in Figure 4.3. For vessels using the Seatainer terminal, time available for working cargo generally constituted a greater proportion of alongside time than for vessels using the Glebe Island terminal. For example, for 38 per cent of vessel visits to the Glebe Island terminal the proportion was less than one-half, whereas for only 19 per cent of vessel visits to the Seatainer terminal was this the case.

Container exchange time

Only for vessel calls at the Seatainer terminal was it possible to determine the precise operational time of the vessel or that time which was spent in the actual exchange of containers to and from the ship or in the repositioning of containers. This time, called the container exchange time, was defined to be the time available for working cargo less the time spent lashing and unlashing containers on board the ship less all other delays which affected the exchange of containers. It was therefore the most precise measure available in this study of the actual time spent exchanging containers. The findings are listed in Tables 4.18 and 4.19.

TABLE 4.16—DISTRIBUTIONS OF TIME AVAILABLE FOR WORKING CARGO PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

	GIT								*STL*							
	1977		*1979*		*1981*		*1977, 1979 and 1981*		*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
Time available (hours)	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0- 8	27	13.7	19	8.4	9	5.7	55	9.5	2	1.3	1	0.7	2	2.1	5	1.3
9-16	26	13.2	33	14.6	8	5.0	67	11.5	2	1.3	3	2.0	3	3.1	8	2.0
17-24	61	31.0	42	18.6	36	22.6	139	23.9	7	4.5	7	4.7	4	4.2	18	4.5
25-32	36	18.3	43	19.0	34	21.4	113	19.4	21	13.6	12	8.1	8	8.3	41	10.3
33-40	24	12.2	46	20.4	24	15.1	94	16.2	21	13.6	17	11.4	8	8.3	46	11.5
41-48	10	5.1	20	8.8	23	14.5	53	9.1	20	13.0	20	13.4	8	8.3	48	12.0
49-56	5	2.5	7	3.1	10	6.3	22	3.8	6	3.9	13	8.7	11	11.5	30	7.5
57-64	8	4.1	15	6.6	12	7.5	35	6.0	41	26.6	33	22.1	25	26.0	99	24.8
65-72	0	0.0	1	0.4	1	0.6	2	0.3	13	8.4	11	7.4	7	7.3	31	7.8
73-80	0	0.0	0	0.0	1	0.6	1	0.2	7	4.5	8	5.4	6	6.3	21	5.3
81-88	0	0.0	0	0.0	0	0.0	0	0.0	8	5.2	9	6.0	1	1.0	18	4.5
89-96	0	0.0	0	0.0	0	0.0	0	0.0	3	1.9	5	3.4	6	6.3	14	3.5
> 96	0	0.0	0	0.0	1	0.6	1	0.2	3	1.9	10	6.7	7	7.3	20	5.0
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Sources: Records of Glebe Island and Seatainer terminals.

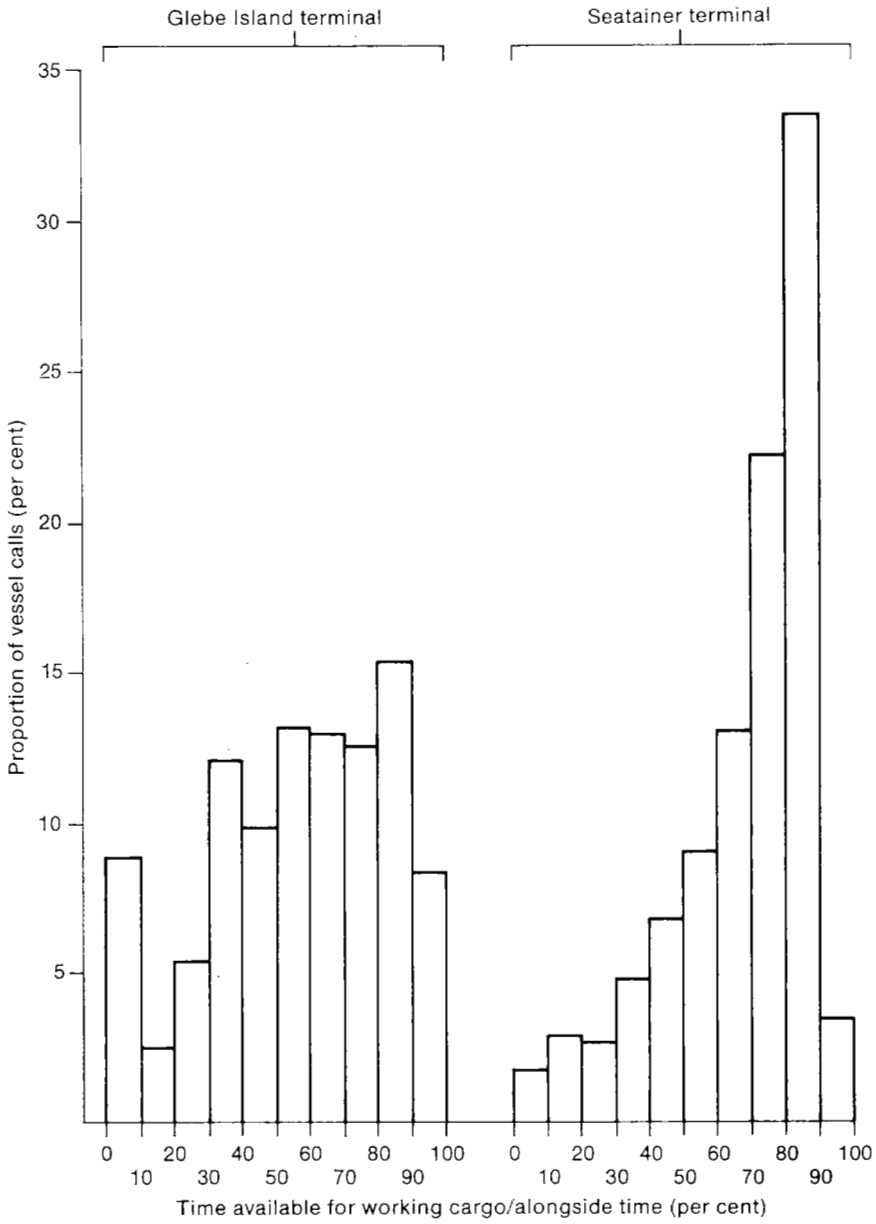

Figure 4.3—Distributions of the proportion that time available for working cargo was of alongside time for vessel calls at the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

TABLE 4.17—DISTRIBUTIONS OF TIME AVAILABLE FOR WORKING CARGO AS A PROPORTION OF ALONGSIDE TIME FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT		STL		GIT and STL	
Proportion (per cent)	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent
0- 10	46	8.8	6	1.7	52	5.9
11- 20	12	2.5	10	2.8	23	2.6
21- 30	28	5.3	9	2.6	37	4.2
31- 40	63	12.0	17	4.8	80	9.1
41- 50	51	9.7	24	6.8	75	8.6
51- 60	68	13.0	32	9.1	100	11.4
61- 70	67	12.8	46	13.1	113	12.9
71- 80	65	12.4	78	22.2	143	16.3
81- 90	81	15.4	118	33.5	199	22.7
91-100	43	8.2	12	3.4	55	6.3
Total	525	100.0	352	100.0	877	100.0

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.18—PARAMETERS OF CONTAINER EXCHANGE TIME FOR VESSEL CALLS AT THE SEATAINER TERMINAL; 1977, 1979 AND 1981

(Hours per ship call)

Measure	1977	1979	1981	1977, 1979 and 1981
Mean	33.4	39.7	37.7	36.8
Standard deviation	20.3	24.7	18.4	21.8
Median	32.0	37.0	37.5	34.6
Mode	33.0	24.0	32.0	19.0
Maximum	214.0	221.0	101.0	221.0

Note: Sample sizes were: 1977, 154 vessel calls; 1979, 149 vessel calls; 1981, 96 vessel calls; aggregate period, 399 vessel calls.

Source: Seatainer terminal records.

The average container exchange time for the three sample years was 37 hours (Table 4.18). As a proportion of the average labour available time (Table 4.10) container exchange time represented 49 per cent of the time and 39 per cent of the average vessel alongside time (Table 4.6). The distribution of the proportion that container exchange time was of alongside time (Table 4.19) provides a more accurate picture. For 31 per cent of vessel calls the proportion of container exchange time to alongside time was between 50 and 60 per cent; for 74 per cent of vessel calls it was between 30 and 60 per cent, and for only 8 per cent of vessel calls was the container exchange time greater than 60 per cent of the alongside time.

Non-operational delay time

Non-operational delay times, those due to delays attributable to industrial disputes, unfavourable weather conditions, ship equipment breakdown etc, were characterised by an extremely high degree of variability, ranging for example from a thirty minute stopwork meeting to a prolonged strike. The average delay time at the Seatainer terminal was 19 hours, about three times that at the Glebe Island terminal (Table 4.20).

TABLE 4.19—DISTRIBUTION OF CONTAINER EXCHANGE TIME AS A PROPORTION OF ALONGSIDE TIME FOR VESSEL CALLS AT THE SEATAINER TERMINAL; AGGREGATED OVER 1977, 1979 AND 1981

Proportion (per cent)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 10	11	3.1	3.1
11- 20	12	3.4	6.6
21- 30	39	11.1	17.7
31- 40	57	16.2	33.9
41- 50	97	27.6	61.5
51- 60	107	30.5	92.0
61- 70	24	6.8	98.9
71- 80	1	0.3	99.1
81- 90	0	0.0	99.1
91-100	3	0.9	100.0
Total	351	100.0	

Source: Seatainer terminal records.

TABLE 4.20—PARAMETERS OF NON-OPERATIONAL DELAY TIMES FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(Hours per ship call)

Measure	*GIT*	*STL*
Mean	6.0	18.5
Standard deviation	15.7	41.7
Median	1.4	9.8
Mode	1.0	4.0
Maximum	213.0	722.0

Notes: 1. Sample sizes were: GIT, 582 vessel calls; STL, 399 vessel calls.
2. The parameter values clearly indicate highly skewed distributions and the means are therefore unreliable indicators of central tendencies.

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.21—DISTRIBUTION OF NON-OPERATIONAL DELAY TIME PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Delay time (hours)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 8	643	65.6	65.6
9-16	155	15.8	81.4
17-24	54	5.5	86.9
25-32	28	2.9	89.8
33-40	33	3.4	93.2
41-48	15	1.5	94.7
49-56	12	1.2	95.9
57-64	16	1.6	97.5
65-72	8	0.8	98.3
> 72	17	1.7	100.0
Total	981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

Over the three sample years however, and for both terminals, two-thirds of non-operational delay times were less than eight hours (Table 4.21). What appears to be a very low proportion of delay times exceeding 72 hours (2 per cent) however (see Tables 4.21 and 4.22) included severe periods of industrial disputation. In 1979 for example, four of the five non-operational delays listed as exceeding 72 hours for Glebe Island terminal in fact lasted for seven, nine, ten and twelve days respectively. In 1981, of the two delays greater than 72 hours, one lasted for five days and the second for 19 days. To some extent therefore, the tables understate severe non-operational delay problems, particularly those related to industrial problems. Nonetheless, the delay times are a gross indicator of the times which the terminals were unable to work for all kinds of non-operational reasons.

Clearly from Table 4.22, the distribution patterns of non-operational delay times over the aggregate period for the two terminals were markedly different. For example, the proportion of less than eight hour delays for the Glebe Island terminal was double that for the Seatainer terminal. It was not possible to disaggregate the data to define precisely the components of the non-operational delay times, but it is surmised that the higher concentration of non-operational delay times longer than eight hours may, at least partly, reflect a basic difference in the industrial policies followed by the managements of the two terminals.

Table 4.23 lists the non-operational delay times as a proportion of alongside time for the two terminals over the sample period. Delays at the Glebe Island terminal were concentrated in class intervals with a low ratio of delay time to alongside time while those at the Seatainer terminal were more spread out. Thus nearly 80 per cent of the non-operational delays at Glebe Island represented less than 10 per cent of alongside time whereas only 36 per cent of delays at the Seatainer terminal were this low.

CONTAINER HANDLING RATES

The data available from the records at the two terminals allowed three measures of container handling rates to be established:

- alongside handling rate, derived from the alongside time;
- container working rate, derived from the time available for working cargo; and
- net container working rate, derived from the container exchange time.

Since container exchange times were not available for Glebe Island it was not possible to determine net container working rates for this terminal.

Alongside handling rate

This rate is defined as the total number of containers, expressed as TEUs, handled per hour of vessel alongside time. It includes the exchange of containers to and from the ship and restow movements. No allowance is made for delays of any kind so that the rate is a general measure of the overall productivity of the ship during its stay at the terminal. The parameters and distributions of alongside handling rates are shown in Tables 4.24, 4.25 and 4.26 and the average distribution for each terminal is plotted in Figure 4.4.

Table 4.24 shows that the parameters of the alongside handling rate distributions for the two terminals are virtually identical with the same mean rate of 9.4 TEUs per hour. For more than one-third of all vessel visits the rate was between 6 and 10 TEUs per hour (Table 4.25). The distributions for each year for both terminals were very similar, as might be expected from the nearly identical parameter values. In each year at each terminal, with the exception of the Seatainer terminal in 1977, the modal class was 6–10 TEUs per hour. Rates at the Seatainer terminal in 1977 tended to be higher than those in other years at both terminals and the modal class for that year was 11–15 TEUs per hour (Table 4.26).

TABLE 4.22—DISTRIBUTIONS OF NON-OPERATIONAL DELAY TIME PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

	GIT								*STL*							
	1977		*1979*		*1981*		*1977, 1979 and 1981*		*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
Delay time (hours)	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0– 8	160	81.3	192	85.0	130	81.8	482	82.9	74	48.1	55	36.9	32	33.3	161	40.4
9–16	14	7.1	14	6.2	13	8.2	41	7.1	48	31.2	47	31.5	19	19.8	114	28.6
17–24	8	4.1	5	2.2	1	0.6	14	2.4	13	8.4	13	8.7	14	14.6	40	10.0
25–32	1	0.5	1	0.4	4	2.5	6	1.0	6	3.9	9	6.0	7	7.3	22	5.5
33–40	5	2.5	3	1.3	3	1.9	11	1.9	6	3.9	6	4.0	10	10.4	22	5.5
41–48	1	0.5	4	1.8	1	0.6	6	1.0	2	1.3	2	1.3	5	5.2	9	2.3
49–56	2	1.0	4	1.8	1	0.6	3	0.5	0	0.0	5	3.4	4	4.2	9	2.3
57–64	2	1.0	1	0.4	3	1.9	6	1.0	1	0.6	8	5.4	1	1.0	10	2.4
65–72	0	0.0	1	0.4	1	0.6	2	0.3	3	1.9	2	1.4	1	1.0	6	1.5
> 72	4	2.0	5	2.2	2	1.3	11	1.9	1	0.6	2	1.4	3	3.0	6	1.5
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.23—DISTRIBUTIONS OF THE NON-OPERATIONAL DELAY TIME AS A PROPORTION OF ALONGSIDE TIME FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

	GIT		STL		GIT and STL	
Proportion (per cent)	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0- 10	447	78.4	140	36.2	587	61.3
11- 20	60	10.5	122	31.5	182	19.0
21- 30	13	2.3	59	15.2	72	7.5
31- 40	15	2.6	15	3.9	30	3.1
41- 50	10	1.8	17	4.4	27	2.8
51- 60	5	0.9	4	1.0	9	0.9
61- 70	5	0.9	2	0.5	7	0.7
71- 80	3	0.5	4	1.0	7	0.7
81- 90	2	0.4	2	0.5	4	0.4
91-100	10	1.8	22	5.7	32	3.3
Total	570	100.0	387	100.0	957	100.0

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.24—PARAMETERS OF ALONGSIDE HANDLING RATES FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(TEUs per hour of alongside time)

Parameter	*GIT*	*STL*
Mean	9.4	9.4
Standard deviation	4.7	4.6
Median	8.7	9.2
Mode	8.4	8.0
Maximum	22.5	22.0

Note: Sample sizes were: GIT, 585 vessel calls; STL, 399 vessel calls.

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.25—DISTRIBUTION OF ALONGSIDE HANDLING RATE PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Handling rate (per cent)	*Ship calls*	*Per cent of total*	*Cumulative per cent*
0- 5	180	18.3	18.3
6-10	382	38.8	57.1
11-15	279	28.4	85.5
16-20	131	13.3	98.8
21-25	12	1.2	100.0
Total	984	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.26—DISTRIBUTIONS OF ALONGSIDE HANDLING RATE PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

Handling rate (TEU's per hour)	GIT								STL							
	1977		1979		1981		1977, 1979 and 1981		1977		1979		1981		1977, 1979 and 1981	
	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent
0- 5	38	19.2	46	20.4	32	19.9	116	19.8	19	12.3	24	16.1	21	21.9	64	16.0
6-10	68	34.3	88	38.9	76	47.2	232	39.7	51	33.1	66	44.3	33	34.4	150	37.6
11-15	50	25.3	67	29.6	34	21.1	151	25.8	56	36.4	45	30.2	27	28.1	128	32.1
16-20	38	19.2	23	10.2	16	9.9	77	13.2	27	17.5	13	8.7	14	14.6	54	13.5
21-25	4	2.0	2	0.9	3	1.9	9	1.5	1	0.6	1	0.7	1	1.0	3	0.8
Total	198	100.0	226	100.0	161	100.0	585	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Sources: Records of Glebe Island and Seatainer terminals.

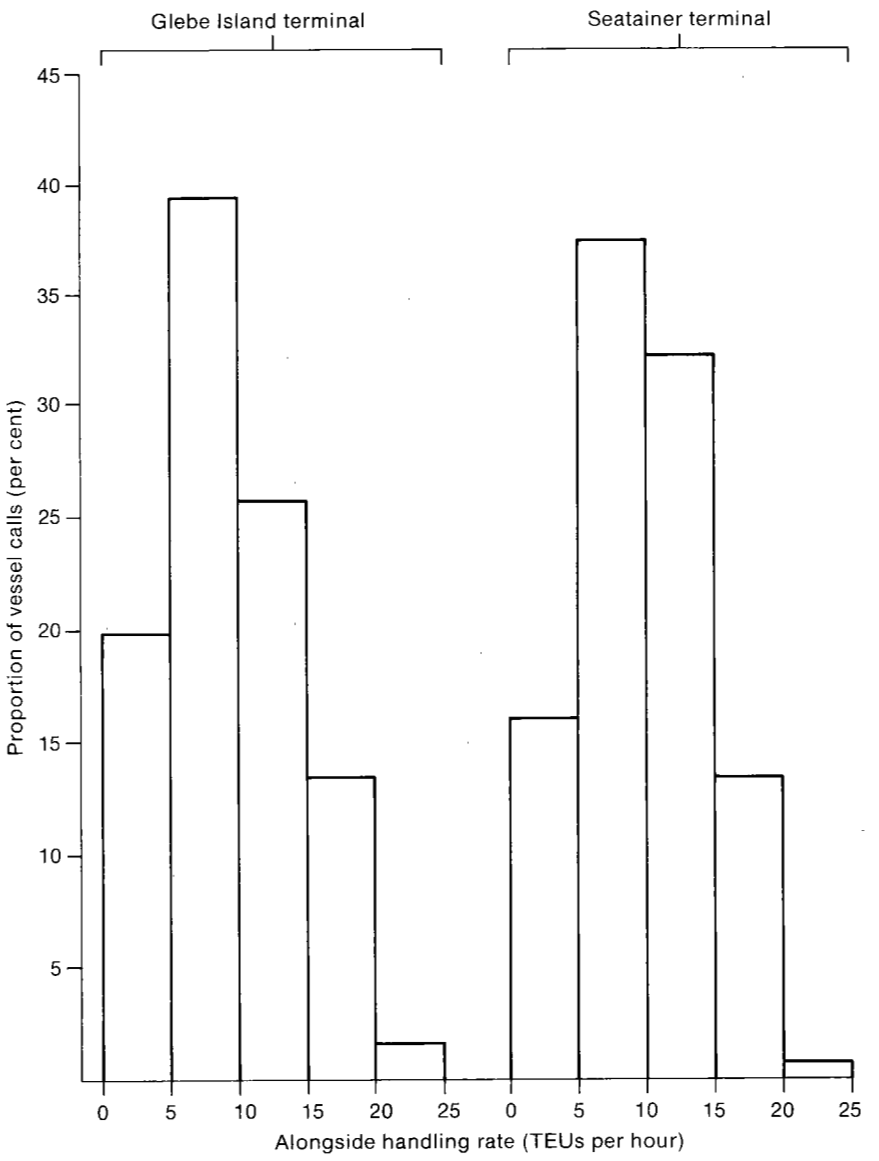

Figure 4.4—Distributions of alongside handling rate per vessel call for the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

Container working rate

A more refined measure of the rate at which containers were handled was obtained by calculating the number of containers (TEUs) handled for the period of time which was available for working cargo (that is, the alongside time less the time labour was not available to the ship less non-operational delay time). The rate is referred to here as the container working rate and values are shown in Tables 4.27, 4.28 and 4.29. The average distribution for each terminal is plotted in Figure 4.5.

The average rates for the two terminals, both about 14 TEUs per hour, were nearly 50 per cent higher than the average alongside rates shown in Table 4.24. Furthermore, the variation in the container working rate was less than that of the alongside rate and virtually the same for both terminals (36 per cent for the Seatainer terminal and 37 per cent for the Glebe Island terminal) (Table 4.27).

TABLE 4.27—PARAMETERS OF CONTAINER WORKING RATES FOR VESSEL CALLS AT THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

(TEUs per hour of time available for working cargo)

Parameter	*GIT*	*STL*	*GIT and STL*
Mean	14.4	13.5	14.0
Standard deviation	5.3	4.9	5.2
Median	14.3	12.7	13.5
Mode	11.0	12.0	11.0
Maximum	32.0	35.0	35.0

Note: Sample sizes were: GIT, 582 vessel calls; STL, 399 vessel calls; total, 981 vessel calls.

Sources: Records of Glebe Island and Seatainer terminals.

TABLE 4.28—DISTRIBUTION OF CONTAINER WORKING RATE PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Container working rate (TEUs per hour)	*Ship calls*	*per cent*	*Cumulative per cent*
0- 5	21	2.1	2.1
6-10	149	15.2	17.3
11-15	393	40.1	57.4
16-20	282	28.7	86.1
21-25	111	11.3	97.5
26-30	20	2.0	99.5
31-35	4	0.4	99.9
36-40	1	0.1	100.0
Total	981	100.0	

Sources: Records of Glebe Island and Seatainer terminals.

Again the general impression from the distribution of container working rates over the three separate years (Table 4.29) was one of similarity rather than striking difference and a relative stability in average container working rates over the three years. This is not to say that there were not differences between the various distributions. There was a higher proportion of vessels in the 11-15 TEUs per hour group for the Seatainer terminal than for Glebe Island over the aggregate period, although Glebe Island had a higher proportion of ships which handled more than 15 TEUs per hour (47 per cent compared with 36 per cent for the Seatainer terminal).

TABLE 4.29—DISTRIBUTIONS OF CONTAINER WORKING RATE PER VESSEL CALL FOR THE GLEBE ISLAND AND SEATAINER TERMINALS; 1977, 1979 AND 1981

Container working rate (TEUs per hour)	GIT								STL							
	1977		1979		1981		1977, 1979 and 1981		1977		1979		1981		1977, 1979 and 1981	
	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent	Ship calls	per cent
0– 5	11	5.6	4	1.8	2	1.3	17	2.9	3	1.9	0	0.0	1	1.0	4	1.0
6–10	21	10.7	30	13.3	24	15.1	75	12.9	27	17.5	29	19.5	18	18.8	74	18.5
11–15	67	34	84	37.2	63	39.6	214	36.8	71	46.1	72	48.3	36	37.5	179	44.9
16–20	48	29.4	80	35.4	50	31.4	188	32.3	36	23.4	32	21.5	26	27.1	94	23.6
21–25	31	15.7	24	10.6	18	11.3	73	12.5	13	8.4	12	8.1	13	13.5	38	9.5
26–30	8	4.1	3	1.3	1	0.6	12	2.1	4	2.6	2	1.3	2	2.1	8	2.0
31–35	1	0.5	1	0.4	1	0.6	3	0.5	0	0.0	1	0.7	0	0.0	1	0.3
36–40	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0	1	0.3
> 40	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	197	100.0	226	100.0	159	100.0	582	100.0	154	100.0	149	100.0	96	100.0	399	100.0

Sources: Records of Glebe Island and Seatainer terminals.

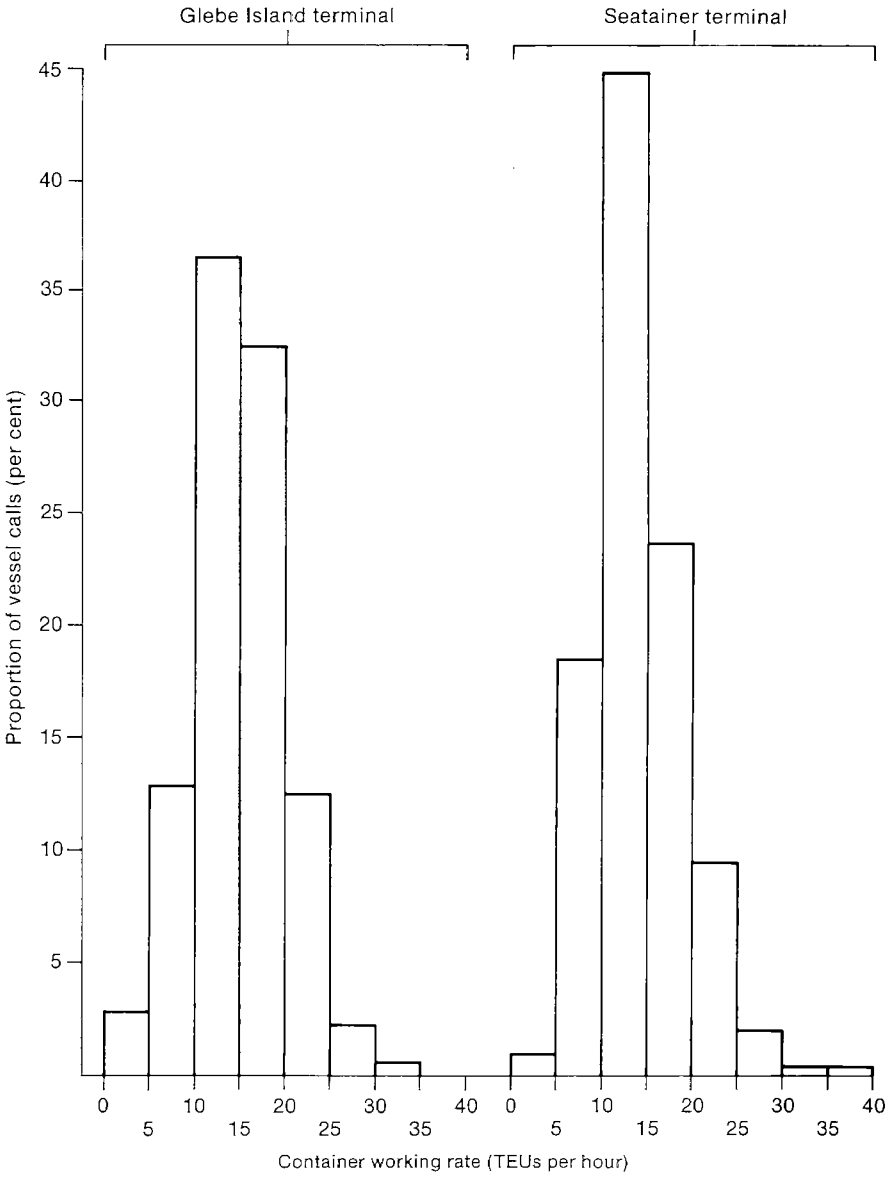

Figure 4.5—Distributions of container working rate per vessel call for the Glebe Island and Seatainer terminals; aggregated over 1977, 1979 and 1981

Net container handling rate

Delays to container handling that occurred during the time labour was assigned to a vessel mean that not all of this time was available for the exchange of containers. Consequently an improved measure of the container handling rate was determined by taking all delays into account. This rate is described here as the net container handling rate and is defined to be the number of TEUs handled per hour of container exchange time. The net container handling rate takes into account the time spent lashing and unlashing containers as well as terminal delays. The data required to determine the net container handling rate were only available for the Seatainer terminal.

The average value of the net container handling rate was considerably higher, as expected, than for other rates, averaging 22 TEUs per hour (Table 4.30). The average rate for each year was approximately constant and the standard deviation ranged from 31 per cent of the average rate in 1977 to 27 per cent in 1981.

TABLE 4.30—PARAMETERS OF NET CONTAINER HANDLING RATES FOR VESSEL CALLS AT THE SEATAINER TERMINAL; 1977, 1979 AND 1981

(TEUs per hour of container exchange time)

Parameter	*1977*	*1979*	*1981*	*1977, 1979 and 1981*
Mean	22.0	20.5	22.1	21.5
Standard deviation	6.7	6.3	6.0	6.4
Median	21.8	20.0	22.0	21.0
Mode	19.0	20.0	20.0	20.0
Maximum	36.0	44.0	41.0	44.0

Note: Sample sizes were: 1977, 154 vessel calls; 1979, 149 vessel calls; 1981, 96 vessel calls; aggregate period, 399 vessel calls.

Source: Seatainer terminal records.

Table 4.31 shows the distribution of net container handling rates for each of the three years and for the aggregate period. It can be seen that, for 62 per cent of vessel visits over the aggregate period, a rate greater than 20 TEUs per hour was achieved. The modal class interval was 21-25 TEU's per hour.

TABLE 4.31—DISTRIBUTIONS OF NET CONTAINER HANDLING RATE PER VESSEL CALL FOR THE SEATAINER TERMINAL; 1977, 1979 AND 1981

	1977		*1979*		*1981*		*1977, 1979 and 1981*	
Net rate (TEUs per hour)	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*	*Ship calls*	*per cent*
0- 5	4	2.6	2	1.3	0	0.0	6	1.5
6-10	0	0.0	1	0.7	0	0.0	1	0.3
11-15	10	6.5	20	13.4	10	10.4	40	10.0
16-20	40	26.0	44	29.5	20	20.8	104	26.1
21-25	54	35.1	48	32.2	34	35.4	136	34.1
26-30	25	16.2	22	14.8	23	24.0	70	17.5
31-35	17	11.0	9	6.0	7	7.3	33	8.3
36-40	4	2.6	2	1.3	1	1.0	7	1.8
> 40	0	0.0	1	0.7	1	1.0	2	0.5
Total	154	100.0	149	100.0	96	100.0	399	100.0

Source: Seatainer terminal records.

SUMMARY

In this chapter the progressive disaggregation of alongside time has demonstrated the large proportion of time that container ships spent at berth during which containers were not being exchanged. Figure 4.6 summarises the mean component times for each terminal. Whilst some significant differences between the two terminals in the various component times of the time at berth have been revealed, container handling rates, variously defined, were remarkably similar. This raises some interesting issues and further comment is made in Chapter 6.

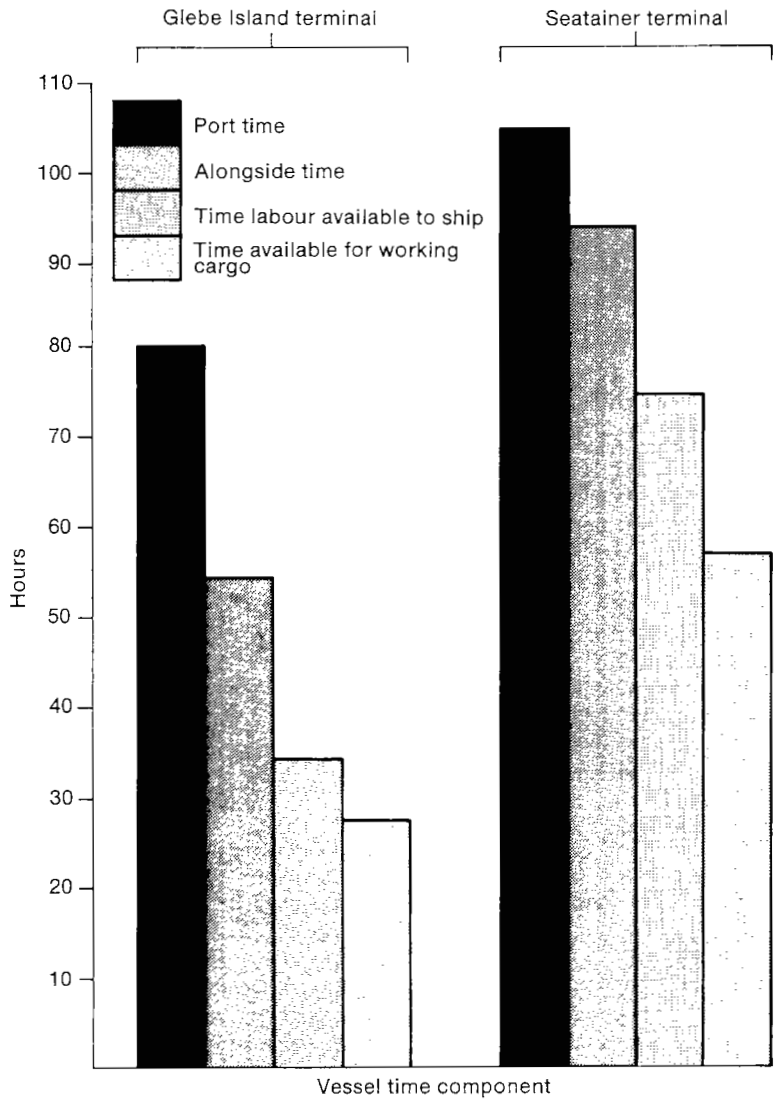

Figure 4.6—Mean values of vessel time components for the Glebe Island and Seatainer terminals

CHAPTER 5—TERMINAL UTILISATION: A CASE STUDY OF THE GLEBE ISLAND TERMINAL

The availability of data on a week-by-week basis for the Glebe Island terminal provided an opportunity to assess some additional productivity characteristics of the terminal and to gain some insights into the operation of an intensively utilised common-user container facility. Equivalent data for the Seatainer terminal were not available.

In this chapter the following aspects of weekly terminal operations at Glebe Island are examined:

- berth occupancy and utilisation
- container throughput in total and by mode
- labour availability
- equipment downtime.

BERTH OCCUPANCY AND UTILISATION

The original data on berth occupancy and utilisation were recorded on a shift-by-shift basis, with the number of containers handled per shift noted, together with the period the ship spent either working or idle. The number of ships alongside was therefore easily determined for each week and year, as was the number of shifts (and part shifts) for which vessels were alongside and either working or idle. These data have been analysed for the sample period and the results are presented in Tables 5.1 to 5.7.

For the three sample years there were, on average, five ships alongside the terminal's two berths for some period of time in any one week, although in the peak year 1979 the average was closer to six, with fewer vessels in 1981 (Table 5.1). However, for almost 80 per cent of the time there were between four and seven vessels at the berths and for seven weeks during the three years there were either eight or nine vessels. Only for two weeks in the three sample years were there less than two vessels alongside (Table 5.2). The busiest year was 1979; for 29 weeks (or 55 per cent) of the year there were between six and nine ships alongside and for more than a quarter of the year (14 weeks) there were either seven, eight or nine ships alongside.

The level of activity at the terminal is also apparent from values of the total number of shifts with ships alongside, shown in Table 5.3. For each of the two berths, 21 shifts were available each week so that if both berths were occupied for an entire week the value of alongside time, in this context, would be 42 shifts. When the data were recorded, a part shift was counted as one shift.

Over the three sample years, ships occupied the berths for an average of 27 shifts each week (Table 5.1), although in the peak year 1979 the average was 32 shifts. It can be seen from Table 5.3 that not only were terminal occupancy ratios[1] extremely high, but high ratios were sustained over much of the period under review. For 42 weeks in the three years terminal occupancy exceeded 85 per cent and for 70 weeks occupancy was at least 72 per cent. In the peak year, terminal berth occupancy for almost half the year (24 weeks) exceeded 85 per cent.

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1. Terminal occupancy ratio is the number of shifts per week with ships alongside divided by the total number of shifts available per week.

TABLE 5.1—MEAN AND STANDARD DEVIATION OF SELECTED VARIABLES OF WEEKLY TERMINAL OPERATIONS; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

(Number per week)

	1977		1979		1981		1977, 1979 and 1981	
Variable	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*	*Mean*	*sd*
Ships alongside	4.7	1.5	5.6	1.7	4.4	1.5	4.9	1.6
Shifts with ships alongside	23.7	10.4	32.3	7.9	25.8	10.5	27.3	10.3
Shifts with ships alongside and being worked	15.6	5.2	19.9	7.5	17.2	6.8	17.5	6.8
Shifts with ships alongside and not being worked	8.1	7.7	12.4	9.5	8.6	6.4	9.7	8.1
Shifts without labour	2.8	3.3	3.7	5.9	3.2	11.6	3.2	7.7
Shifts with portainer out of action for at least part of shift	7.7	4.2	9.2	6.0	9.2	6.0	8.7	5.5
Shifts with transtainer out of action for at least part of shift	11.2	6.7	12.8	6.9	14.9	10.4	13.0	8.3
Hours that portainer out of action	17.5	21.0	15.5	14.7	31.4	48.8	21.5	32.4
Hours that transtainer out of action	34.6	34.3	32.0	27.2	60.1	68.5	42.2	48.4
Hours that either portainer or transtainer out of action	52.2	46.8	47.5	33.0	91.5	81.0	63.7	60.3
Containers handled	1411	523	1688	678	1373	640	1490	629
Containers handled by road	914	281	1212	428	1078	379	1068	385
Containers handled by rail	409	161	371	185	264	137	348	172
Men working (man-shifts)[a]	468	84	539	197	502	133	503	148
Containers handled per man-shift[b]	3.0	na	3.1	na	2.7	na	3.0	na

a. Container handling operations only. Administrative staff not included.
b. Mean number of containers handled per week divided by the mean number of man-shifts per week.
sd standard deviation
na not available

Source: Glebe Island terminal records.

The three-year average (Table 5.1) for the number of shifts for which vessels were alongside and working was 18, somewhat less than the 27 shifts for the average number of shifts during which ships were alongside the terminal. It has not been possible to quantitatively determine the reasons for this difference, but it is, in fact, a measure of the time during which vessels were 'doing nothing' for various reasons. The practice at Glebe Island terminal of working only one vessel at a time, imposed by the inadequacy of the terminal to accept more containers, meant that for much of the time two vessels occupied the terminal berths although only one was worked.

Total working time exceeded 20 shifts per week for 38 per cent of the aggregate period, although the proportion varied a great deal between individual years; in 1977 it was 17 per cent, in 1979 it was 62 per cent, and in 1981 it decreased to 34 per cent (Table 5.4).

TABLE 5.2—DISTRIBUTIONS OF THE NUMBER OF SHIPS ALONGSIDE PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of ships	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0	0	0.0	0	0.0	2	3.8	2	1.3
1	0	0.0	0	0.0	0	0.0	0	0.0
2	4	7.5	4	7.5	4	7.5	12	7.5
3	8	15.1	1	1.9	5	9.4	14	8.8
4	12	22.6	7	13.2	17	32.1	36	22.6
5	10	18.9	12	22.6	13	24.5	35	22.0
6	14	26.4	15	28.3	9	17.0	38	23.9
7	5	9.4	7	13.2	3	5.7	15	9.4
8	0	0.0	5	9.4	0	0.0	5	3.1
9	0	0.0	2	3.8	0	0.0	2	1.3
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

Table 5.5 shows the proportion of shifts worked per week to the number of alongside shifts per week over the aggregate period. For 53 weeks (one-third of the time) the proportion of working time to alongside time was over 90 per cent. On the other hand for 28 weeks (18 per cent of the time) less than half of weekly alongside time was spent with vessels being worked.

The distribution of non-working times listed in Tables 5.6 and 5.7 provide an alternative perspective to the previous figures. Regrettably, comparative figures for other terminals were not available so it is difficult to judge the normality of the values. However, the aggregate values for non-work times reveal that, despite high berth occupancies, there remained some 'spare' capacity that under ideal conditions could be used to boost total throughputs.

For almost 10 per cent of the three-year period (15 weeks) the total number of shifts not worked, although ships were alongside, exceeded 20 per week (Table 5.6). Nonetheless, for 100 of 159 weeks (63 per cent of the time) the number of alongside shifts not worked was less than 11.

Table 5.7 shows the distribution of the ratio of non-work time to alongside time over the three-year period. Again, as for the distribution of the ratio of work time to alongside time in Table 5.5, there is a considerable spread of values. For 82 per cent of the three-year period the value of the ratio of non-work time to alongside time was less than or equal to 50 per cent.

TABLE 5.3—DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK WITH SHIPS ALONGSIDE; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts	*Terminal occupancy ratio*[a]	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
		Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0- 5	0–0.12	0	0.0	0	0.0	3	5.7	3	1.9
6–10	0.14–0.24	5	9.4	1	1.9	1	1.9	7	4.4
11–15	0.26–0.36	7	13.2	1	1.9	7	13.2	15	9.4
16–20	0.38–0.48	12	22.6	3	5.7	2	3.8	17	10.7
21–25	0.50–0.60	7	13.2	5	9.4	9	17.0	21	13.2
26–30	0.62–0.72	7	13.2	7	13.2	12	22.6	26	16.4
31–35	0.74–0.84	7	13.2	12	22.6	9	17.0	28	17.6
36–40	0.86–0.96	4	7.6	19	35.8	8	15.1	31	19.5
41–42	0.98–1.00	4	7.6	5	9.4	2	3.8	11	7.0
Total	53	100.0	53	100.0	53	100.0	159	100.0	

a. Number of shifts per week with ships alongside divided by the total number of shifts available per week.

Source: Glebe Island terminal records.

TABLE 5.4—DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK WITH SHIPS ALONGSIDE AND BEING WORKED; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 5	3	5.7	4	7.5	5	9.4	12	7.5
6-10	4	7.5	2	3.8	3	5.7	9	5.7
11-15	19	35.8	8	15.1	9	17.0	36	22.6
16-20	18	34.0	6	11.3	18	34.0	42	26.4
21-25	8	15.1	22	41.5	16	30.2	46	28.9
26-30	1	1.9	11	20.8	2	3.8	14	8.8
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

TABLE 5.5—DISTRIBUTION OF THE NUMBER OF SHIFTS WORKED PER WEEK AS A PROPORTION OF THE NUMBER OF SHIFTS PER WEEK WITH SHIPS ALONGSIDE; GLEBE ISLAND TERMINAL, AGGREGATED OVER 1977, 1979 AND 1981

Proportion (per cent)	Weeks	per cent
0- 10	5	3.1
11- 20	2	1.3
21- 30	5	3.1
31- 40	5	3.1
41- 50	11	6.9
51- 60	15	9.5
61- 70	30	18.9
71- 80	33	20.8
81- 90	0	0.0
91-100	53	33.3
Total	159	100.0

Source: Glebe Island terminal records.

TABLE 5.6—DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK WITH SHIPS ALONGSIDE BUT NOT BEING WORKED; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 5	26	49.1	12	22.6	17	32.1	55	34.6
6-10	12	22.6	16	30.2	17	32.1	45	28.3
11-15	6	11.3	12	22.6	10	18.9	28	17.6
16-20	4	7.5	5	9.4	7	13.2	16	10.1
21-25	3	5.7	2	3.8	2	3.8	7	4.4
26-30	2	3.8	3	5.7	0	0.0	5	3.1
> 30	0	0.0	3	5.7	0	0.0	3	1.9
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

The above analysis of berth occupancy and utilisation clearly demonstrates that the demand for terminal berths was high over the 1977 to 1981 period. It also reveals that, even in such an intensively utilised terminal, non-work time was not an insignificant proportion of total alongside time.

TABLE 5.7—DISTRIBUTION OF THE NUMBER OF SHIFTS NOT WORKED PER WEEK AS A PROPORTION OF THE NUMBER OF SHIFTS PER WEEK WITH SHIPS ALONGSIDE; GLEBE ISLAND TERMINAL, AGGREGATED OVER 1977, 1979 AND 1981

Proportion (per cent)	*Weeks*	*per cent*
0- 10	25	15.7
11- 20	21	12.3
21- 30	35	22.0
31- 40	34	21.4
41- 50	16	10.1
51- 60	9	5.7
61- 70	4	2.5
71- 80	5	3.1
81- 90	0	0.0
91-100	10	6.3
Total	159	100.0

Source: Glebe Island terminal records.

CONTAINER THROUGHPUT

The average number of containers handled per week to and from the terminal over the three sample years was approximately 1500 with, on average, about three containers being handled per man-shift (Table 5.1). For approximately 60 per cent of the time (93 weeks) weekly throughout was between 1001 and 2000 and for 32 weeks (20 per cent of the time) more than 2000 containers were handled per week (Table 5.8). In 1979 however the terminal handled a significantly larger number of containers than in the other two years with the result that throughputs greater than 2000 were achieved for 19 weeks of that year (36 per cent of the time).

TABLE 5.8—DISTRIBUTIONS OF THE NUMBER OF CONTAINERS HANDLED PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of containers	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0- 250	0	0.0	3	5.7	4	7.5	7	4.4
251- 500	1	1.9	2	3.8	2	3.8	5	3.1
501- 750	7	13.2	2	3.8	2	3.8	11	6.9
751-1000	5	9.4	1	1.9	5	9.4	11	6.9
1001-1250	5	9.4	2	3.8	5	9.4	12	7.5
1251-1500	10	18.9	5	9.4	10	18.9	25	15.7
1501-1750	10	18.9	5	9.4	9	17.0	24	15.1
1751-2000	10	18.9	14	26.4	8	15.1	32	20.1
2001-2250	3	5.7	10	18.9	4	7.5	17	10.7
2251-2500	1	1.9	8	15.1	3	5.7	12	7.5
> 2500	1	1.9	1	1.9	1	1.9	3	1.9
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

The terminal was (and continues to be) oriented to road transport and container movements by road to and from the terminal were about three times that by rail. For the three-year period an average of 1068 containers were moved by road each week compared with 348 by rail (Table 5.1). For about 70 per cent of the time the number handled was between 751 and 1500 (Table 5.9) although for 12 per cent of the time the volume exceeded 1500. For about one month each year volumes handled were less than or equal to 500.

TABLE 5.9—DISTRIBUTIONS OF THE NUMBER OF CONTAINERS HANDLED BY ROAD PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 250	1	1.9	3	5.7	2	3.8	6	3.8
251- 500	3	5.7	3	5.7	1	1.9	7	4.4
501- 750	9	17.0	1	1.9	6	11.3	16	10.1
751-1000	20	37.7	4	7.5	11	20.8	35	22.0
1001-1250	15	28.3	11	20.8	17	32.1	43	27.0
1251-1500	4	7.5	18	34.0	11	20.8	33	20.8
1501-1750	1	1.9	11	20.8	4	7.5	16	10.1
1751-2000	0	0.0	2	3.8	1	1.9	3	1.9
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

The difference between the Seatainer and the Glebe Island terminals in respect of their dependence on rail movements to and from outside depots has been noted in Chapter 3 and the figures above indicate how dominant road movements have been for Glebe Island terminal. Moreover the loss of the ACTA trade through the terminal, with its rail link to the Freightbases depot at Villawood, and the consequent drop in importance of rail handling at the terminal, is revealed in the 1981 figures (Table 5.10). In 1977 and 1979 less than 500 containers were handled by rail each week for about 70 per cent and 74 per cent of the period respectively. In 1981 the average number of containers handled by rail had fallen to 264 (Table 5.1) and for virtually the whole year less than or equal to 500 containers were handled by rail each week.

TABLE 5.10—DISTRIBUTIONS OF THE NUMBER OF CONTAINERS HANDLED BY RAIL PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of containers	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 250	7	13.2	12	22.6	25	47.2	44	27.7
251- 500	29	54.7	27	50.9	26	49.1	82	51.6
501- 750	16	30.2	13	24.5	2	3.8	31	19.5
751-1000	1	1.9	1	1.9	0	0.0	2	1.3
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

LABOUR AVAILABILITY

The average number of man-shifts each week at the terminal over the three years varied from 468 in 1977 to 539 in 1979. For most weeks in each year, the number of men working represented nearly a full complement of workers at the terminal.

In 1977 for 83 per cent of the time almost all of the labour force was working; in 1979 and 1981 the figures were 81 and 87 per cent respectively (Table 5.11). Industrial disputes, terminal close-downs and cancelled shifts, for example, reduced the total number of men available and the lower numbers of men working each week (see Table 5.11) give an indication of the effects of these factors. For example, 1979 was characterised by quite severe industrial disputation which is reflected in the values for that year. Table 5.12 demonstrates this in terms of the number of shifts which had no labour available. Thus for 84 per cent of the aggregate period there were less than five shifts per week at the terminal without labour. On the other hand for 8 per cent of the time there was no labour for more than 10 shifts in a week (that is, for just under half the total available time), seven of those weeks being in 1979.

TABLE 5.11—DISTRIBUTIONS OF THE NUMBER OF MAN-SHIFTS PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Man shifts per week	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0–100	0	0.0	3	5.7	2	3.8	5	3.3
101–200	1	1.9	3	5.7	0	0.0	4	2.5
201–300	1	1.9	1	1.9	2	3.8	4	2.5
301–400	7	13.2	2	3.8	3	5.7	13	8.2
401–500	23	43.4	2	3.8	9	16.9	34	21.5
501–600	21	39.6	14	26.4	32	60.4	67	42.1
601–700	0	0.0	27	50.8	5	9.4	32	20.1
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

TABLE 5.12–DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK WITHOUT LABOUR; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts without labour	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0– 5	44	83.0	43	81.1	46	86.7	133	83.6
6–10	7	13.2	3	5.7	4	7.6	14	8.8
11–15	1	1.9	2	3.8	2	3.8	5	3.2
16–20	1	1.9	4	7.6	0	0.0	5	3.2
21[a]	0	0.0	1	1.9	1	1.9	2	1.2
Total	53	100.0	53	100.0	53	100.0	159	100.0

a. Maximum number.

Source: Glebe Island terminal records.

EQUIPMENT DOWNTIME

Container terminals are characterised by their dependence on expensive and relatively sophisticated equipment which, at full operational levels, is capable of achieving very high rates of container handling. Equipment failure significantly reduces ship and terminal productivity and terminal operators attempt to minimise equipment downtime.

Glebe Island terminal operated two wharf or portainer cranes and five transtainer or yard gantries for stacking and positioning of containers to or from trucks or internal transfer vehicles. The operational records of this equipment were examined in terms of the number of shifts per week which were affected by downtime, the proportion

of total available shifts affected by equipment downtime and the actual amount of time lost each week for both the two portainers and the five transtainers. Values were also derived for total equipment downtime. The findings are presented in Tables 5.13 to 5.20.

Table 5.13 indicates the extent of dislocation resulting from portainer downtime in terms of whole shifts (that is, regardless of the amount of time lost, which is shown in Table 5.15). The average number of shifts affected over all three years was almost nine per week, with relatively little variation over time. For two-thirds of the three-year period (109 weeks) less than or equal to ten shifts per week were affected, although for slightly less than one week in four, between 11 and 15 shifts were affected by portainer downtime. Similar patterns of downtime occurred in 1979 and 1981, despite the fact that 1979 was a somewhat busier year, while downtime in 1977 was generally less.

The proportions of total available shifts which these values represent are shown in Table 5.14. For more than three weeks in every four over the three years (77 per cent) the proportion of affected shifts to available shifts was less than 30 per cent. For 12 weeks in the three year period however, the proportion of shifts affected was between 60 and 70 per cent of total available shifts.

TABLE 5.13—DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK AFFECTED BY PORTAINER DOWNTIME; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts affected	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0- 5	16	30.1	16	30.1	17	32.0	49	30.8
6-10	26	49.0	16	30.1	14	26.5	56	35.2
11-15	9	17.1	14	26.5	15	28.2	38	23.9
16-20	2	3.8	4	7.6	4	7.6	10	6.3
21-25	0	0.0	2	3.8	1	1.9	4	2.5
> 25	0	0.0	1	1.9	2	3.8	2	1.3
Total	53	100.0	53	100.0	53	100.0	159	100.0

Note: Maximum number of shifts potentially available to two portainers per week = 42.

Source: Glebe Island terminal records.

TABLE 5.14—DISTRIBUTIONS OF THE PROPORTION OF AVAILABLE SHIFTS PER WEEK AFFECTED BY PORTAINER DOWNTIME; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Proportion[a] *(per cent)*	*1977*		*1979*		*1981*		*1977, 1979 and 1981*	
	Weeks	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*	*Weeks*	*per cent*
0-10	15	28.3	13	24.5	8	15.1	36	22.6
11-20	16	30.2	12	22.6	20	37.7	48	30.2
21-30	14	26.4	13	24.5	12	22.6	39	24.5
31-40	8	15.1	5	9.4	4	7.5	17	10.7
41-50	0	0.0	2	3.8	2	3.8	4	2.5
51-60	0	0.0	1	1.9	2	3.8	3	1.9
61-70	0	0.0	7	13.3	5	9.5	12	7.6
Total	53	100.0	53	100.0	53	100.0	159	100.0

a. Number of shifts affected per week by portainer downtime divided by the number of shifts potentially available to the two portainers per week.

Source: Glebe Island terminal records.

The number of shifts affected is only a relatively gross measure of downtime since each delay which lasted for only part of a shift was recorded as a delay for the whole shift. Table 5.15 lists, in eight-hour intervals, the actual total amount of time for which portainers were out of service each week. This table shows that for 42 per cent of the time this total weekly downtime for the two portainer cranes was less than eight hours, for 62 per cent of the time less than 16 hours and for 74 per cent of the time it was less than 24 hours.

TABLE 5.15—DISTRIBUTIONS OF PORTAINER DOWNTIME PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Downtime (hours)	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 8	24	45.2	21	39.6	21	39.6	65	41.5
9-16	14	26.4	12	22.6	6	11.3	32	20.1
17-24	3	5.7	10	18.9	6	11.3	19	12.0
25-32	5	9.4	5	9.4	6	11.3	16	10.1
33-40	2	3.8	1	1.9	4	7.6	7	4.4
41-48	1	1.9	3	5.7	1	1.9	5	3.1
49-56	0	0.0	0	0.0	3	5.7	3	1.9
57-64	2	3.8	0	0.0	0	0.0	2	1.3
65-72	0	0.0	0	0.0	0	0.0	0	0.0
73-80	1	1.9	1	1.9	1	1.9	3	1.9
81-88	0	0.0	0	0.0	1	1.9	1	0.6
89-96	0	0.0	0	0.0	0	0.0	0	0.0
> 96	1	1.9	0	0.0	4	7.6	5	3.1
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

The terminal operated five transtainer cranes throughout the study period and patterns of downtime for this equipment are recorded in Tables 5.16, 5.17 and 5.18.

On average, 13 of the 105 shifts available each week for the five transtainers were affected by transtainer downtime (Table 5.1) and for two-thirds of the three-year period (107 weeks) the number of shifts affected was less than 15. For 12 weeks in the period (ten of them in 1981) transtainer downtime affected between 26 and 40 shifts per week (Table 5.16).

For 78 per cent of the time less than 20 per cent of available shifts were affected by transtainer downtime and on no occasion did the proportion of shifts affected exceed 40 per cent (Table 5.17).

Again, the actual amount of time for which transtainers were out of service (Table 5.18) is a useful measure, although gross shift time gives some indication of the degree of interruption created by transtainer downtime. For about half of the three-year period the aggregate transtainer downtime was less than 24 hours each week and for almost three-quarters of the time it was less than 48 hours. On the other hand for 17 weeks, 12 of them in 1981, transtainer downtime exceeded 96 hours per week. In general terms however, transtainer breakdowns tended to be of relatively short duration.

The aggregate pattern of downtime for the two portainer cranes and the five transtainers is shown in Table 5.19. There is clearly a wide range of values of total equipment downtime, although prior to 1981 weekly downtimes greater than 96 hours were uncommon. The modal class of 25-48 hours encompassed one-third of the total period whilst the average value of 64 hours per week (Table 5.1) was exceeded about 40 per cent of the time. In 1981 the generally longer downtimes resulted in an average of 92 hours per week being lost due to equipment failure (Table 5.1).

TABLE 5.16—DISTRIBUTIONS OF THE NUMBER OF SHIFTS PER WEEK AFFECTED BY TRANSTAINER DOWNTIME; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Number of shifts	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 5	13	24.5	8	15.1	7	13.2	28	17.6
6-10	13	24.5	9	17.0	18	34.0	40	25.2
11-15	17	32.1	16	30.2	6	11.3	39	24.5
16-20	5	9.4	12	22.6	8	15.1	25	15.7
21-25	4	7.6	7	13.2	4	7.5	15	9.4
26-30	0	0.0	1	1.9	5	9.4	6	3.8
31-35	1	1.9	0	0.0	2	3.8	3	1.9
36-40	0	0.0	0	0.0	3	5.7	3	1.9
Total	53	100.0	53	100.0	53	100.0	159	100.0

Note: Maximum number of shifts potentially available to five transtainers per week = 105.

Source: Glebe Island terminal records.

TABLE 5.17—DISTRIBUTIONS OF THE PROPORTION OF AVAILABLE SHIFTS PER WEEK AFFECTED BY TRANSTAINER DOWNTIME; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Proportion[a] (per cent)	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0-10	26	49.1	17	32.1	25	47.2	68	42.8
11-20	18	34.0	25	47.2	13	24.5	56	35.2
21-30	4	7.5	5	9.4	7	13.2	16	10.1
31-40	5	9.4	6	11.3	8	15.1	19	11.9
Total	53	100.0	53	100.0	53	100.0	159	100.0

a. Number of shifts affected per week by transtainer downtime divided by the number of shifts potentially available to the five transtainers per week.

Source: Glebe Island terminal records.

TABLE 5.18—DISTRIBUTIONS OF TRANSTAINER DOWNTIME PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Downtime (hours)	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 8	10	18.9	8	15.1	12	22.6	30	18.8
9-16	8	15.1	5	9.4	6	11.3	19	12.0
17-24	7	13.2	16	30.1	10	18.8	33	20.8
25-32	11	20.7	8	15.1	3	5.7	22	13.8
33-40	4	7.5	3	5.7	1	1.9	8	5.0
41-48	2	3.8	2	3.8	1	1.9	5	3.1
49-56	1	1.9	2	3.8	0	0.0	3	1.9
57-64	3	5.7	1	1.9	2	3.8	6	3.8
65-72	1	1.9	1	1.9	2	3.8	4	2.5
73-80	1	1.9	4	7.5	2	3.8	7	4.4
81-88	0	0.0	1	1.9	1	1.9	2	1.3
89-96	1	1.9	1	1.9	1	1.9	3	1.9
> 96	4	7.5	1	1.9	12	22.6	17	10.7
Total	53	100.0	53	100.0	53	100.0	159	100.0

Source: Glebe Island terminal records.

Table 5.20 puts these values in perspective, for, when measured against total available equipment time, the total equipment downtime varied between zero and 10 per cent for 135 weeks of the three-year period.

TABLE 5.19—DISTRIBUTIONS OF TOTAL EQUIPMENT DOWNTIME PER WEEK; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Downtime (hours)	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0- 24	13	24.5	11	20.7	11	20.7	35	22.0
25- 48	20	37.7	22	41.5	12	22.6	54	34.0
49- 72	11	20.7	8	15.1	5	9.4	24	15.1
73- 96	4	7.6	9	17.0	6	11.3	19	12.0
97-120	0	0.0	2	3.8	2	3.8	4	2.5
121-144	1	1.9	0	0.0	4	7.6	5	3.1
145-168	3	5.7	1	1.9	1	1.9	5	3.1
169-192	0	0.0	0	0.0	4	7.6	4	2.5
193-216	0	0.0	0	0.0	3	5.7	3	1.9
217-240	0	0.0	0	0.0	2	3.8	2	1.3
241-264	1	1.9	0	0.0	2	3.8	3	1.9
265-288	0	0.0	0	0.0	0	0.0	0	0.0
289-312	0	0.0	0	0.0	0	0.0	0	0.0
313-336	0	0.0	0	0.0	1	1.9	1	0.6
Total	53	100.0	53	100.0	53	100.0	159	100.0

Note: Maximum number of hours per week potentially available to two portainers and five transtainers = 1176.

Source: Glebe Island terminal records.

TABLE 5.20—DISTRIBUTIONS OF EQUIPMENT DOWNTIME AS A PROPORTION OF TIME EQUIPMENT WAS AVAILABLE; GLEBE ISLAND TERMINAL, 1977, 1979 AND 1981

Proportion[a] (per cent)	1977		1979		1981		1977, 1979 and 1981	
	Weeks	per cent	Weeks	per cent	Weeks	per cent	Weeks	per cent
0-10	48	90.6	51	96.2	36	67.9	135	84.9
11-20	4	7.5	1	1.9	13	24.5	18	11.4
21-30	1	1.9	1	1.9	3	5.7	5	3.1
31-40	0	0.0	0	0.0	1	1.9	1	0.6
Total	53	100.0	53	100.0	53	100.0	159	100.0

a. Number of hours per week for which equipment was unavailable divided by the number of hours per week for which equipment was potentially available.

Source: Glebe Island terminal records.

CHAPTER 6—CONCLUDING REMARKS

Both the Glebe Island and Seatainer terminals were designed and built in response to the introduction of new general cargo handling techniques in the 1960s. The main aim of this work was to investigate the productivity of these first generation container terminals in order to provide a better understanding of terminal operations and to provide benchmark productivity data for comparison with other terminals, particularly second generation terminals. The time period for this study, 1977 to 1981, was chosen because both terminals had by this time reached a mature phase of operation, with organisational practices well established and high annual throughputs. For these reasons it is likely that the handling rates achieved in this period were close to the maximum achieved by the terminals since they were commissioned.

A detailed analysis of the productivity of the Glebe Island and Seatainer terminals has been described in Chapters 4 and 5. The objective of this final chapter is to review the results presented in these chapters in terms of the physical and operational characteristics of the terminals and the ships which used them. Throughout this chapter, reference will frequently be made to Table 6.1, which summarises the productivity characteristics of each terminal. The data in Table 6.1 refer to averages over the three years 1977, 1979 and 1981.

One of the main results of Chapter 4 was that both terminals achieved identical alongside handling rates (9.4 TEUs per hour of berth time) and almost identical container working rates (14 TEUs per hour spent loading and unloading). In view of the physical and operational differences between the terminals and the very significant differences in the demand characteristics for each terminal, the similarity in the container handling rates is at first-sight surprising.

Quite different technical and operational solutions were devised to overcome the fundamental constraints imposed by the small land area available for each terminal. For example different types of equipment and stack layouts were used. Moreover, there was a definite emphasis towards road transport at the Glebe Island terminal whereas the emphasis was towards rail transport at the Seatainer terminal. No attempt has been made in this work to quantify the effect of site area constraints on terminal productivity. To do this an operational analysis approach would have been required. However, it is interesting to note that both the new (second generation) three berth terminals at Botany Bay occupy site areas about four times larger than the Port Jackson terminals examined in this work.

The differences between the demand characteristics for each terminal were discussed in Chapter 3, where it was shown that each terminal serviced quite different vessel populations. The average size of vessels using the Glebe Island terminal was 18 069 DWT compared with 25 356 DWT at the Seatainer terminal. In fact, almost one-quarter of the ships at Glebe Island were less than 10 000 DWT in the years 1977, 1979 and 1981 and only 6.3 per cent were more than 30 000 DWT. For the Seatainer terminal on the other hand, almost 30 per cent of vessels exceeded 30 000 DWT and more than 50 per cent were over 25 000 DWT.

Moreover, as a common user terminal, Glebe Island serviced a less homogeneous group of vessels so that even within the same size classes there were marked variations in vessel configurations. Ships with containers stowed athwart decks (as, for example, the *Potoi Island* of 7000 DWT), ships without container cell guides, or ships with

TABLE 6.1—COMPARISON OF MEAN VALUES OF DEMAND, OPERATING AND PRODUCTIVITY PARAMETERS OF GLEBE ISLAND AND SEATAINER TERMINALS; AGGREGATED OVER 1977, 1979 AND 1981

Parameter	*GIT*	*STL*
Demand characteristics		
Vessel size (DWT)	18 069	25 356
Load per vessel call (TEU)		
Import	230	439
Export	183	329
Vessel times		
Port time (hours)	80	105
Alongside time (hours)	54	94
Alongside time/port time (per cent)	na	89
Labour available time (hours)	33	75
Labour available time/alongside time (per cent)	66	83
Time available for working cargo (hours)	28	56
Time available for working cargo/alongside time (per cent)	57	68
Non-operational delay time (hours)	6	19
Non-operational delay time/alongside time (per cent)	11	22
Container handling rates		
Alongside handling rate (TEUs per hour)	9.4	9.4
Container working rate (TEUs per hour)	14.4	13.5

na not available

Source: Various tables in Chapters 3 and 4.

less than simple below-deck configurations would be expected to have slower rates of exchange than might otherwise be the case. Ships for which the call was either the first or last port on the other hand should have achieved high rates because only deck containers were handled. As a syndicated terminal, Seatainer serviced larger vessels of similar configurations operating on the long-haul Australia-United Kingdom/Europe route or on the Japan and US routes.

Vessel loads at the two terminals reflected these differences and the average load on vessels using the Seatainer terminal was almost double that for Glebe Island vessels, 768 compared with 413. Moreover, whilst almost one-third of the vessels at the Seatainer terminal exchanged more than 1000 containers, only 2 per cent at Glebe Island handled this number. Any economies of scale in loading or unloading vessels would therefore have favoured the Seatainer terminal.

Thus, on the basis of ship size and type, load sizes and ship call patterns, one would have expected the container handling rates at the Seatainer terminal to have been higher than at Glebe Island. The fact that the same handling rates were achieved at each terminal reflects on the different operational practices and infrastructure at each terminal.

Some of the operational differences can be deduced from the summary results in Table 6.1. For example, vessels at Glebe Island terminal spent longer, on average, waiting to berth than vessels at the Seatainer terminal. The mean port delay times (difference between mean port time and mean alongside time) were about 26 and nine hours at Glebe Island terminal and the Seatainer terminal respectively. There appear to be two possible explanations for this difference. It may have been due to a higher demand for berths at Glebe Island terminal (relative to terminal capacity), with a corresponding increase in average queue length. Alternatively, it may have been easier to schedule the arrival of vessels at the Seatainer terminal because of the nature of the call patterns and, in this way, reduce the average time spent by

ships waiting to berth. It is also interesting to note that there was a positive incentive for the Seatainer terminal management to minimise the port time per vessel call as the Seatainer terminal was owned by companies with ship-operating interests. The effect of vessel demurrage costs therefore had to be considered.

Other differences in the operational characteristics of each terminal are apparent from the breakdown of alongside times into other vessel time parameters (refer Table 6.1). On average, labour was available for 83 per cent of alongside time at the Seatainer terminal but for only 66 per cent of alongside time at Glebe Island terminal. This difference can be partly explained by the practice at Glebe Island terminal of working only one vessel at a time in order to reduce yard congestion. The higher labour availability at the Seatainer terminal was offset to a large extent by higher non-operational delays at that terminal; the non-operational delays at the Seatainer terminal and Glebe Island terminal were, on average, 22 and 11 per cent of alongside times respectively. This difference can probably be explained in terms of the three main causes of non-operational delay, namely industrial disputes, unfavourable weather conditions and ship equipment breakdowns. Weather conditions can immediately be ruled out as a cause of differences between terminals as the terminals were in close proximity and thus the same weather conditions would have been experienced at each terminal. It seems unlikely that the large differences in non-operational delays could be entirely due to differences in the reliability of ship equipment and it therefore seems likely that there was more time lost, on average, by industrial disputes at the Seatainer terminal. This factor must have at least partially offset the more favourable vessel type and load characteristics of the Seatainer terminal traffic.

One of the more noticeable features of the breakdown of alongside times into other vessel time parameters is the large amount of time that vessels were not loading or unloading cargo, even if allowance is made for non-operational delays such as industrial disputes. For example, labour was not made available to vessels at Glebe Island terminal for, on average, about one-third of the time that vessels were berthed at the terminal. This implies that the berths and the wharf cranes were not fully utilised. It does not necessarily imply that the potential of the terminals as a whole was not fully realised because conclusions about terminal utilisation cannot be drawn from an examination of individual terminal subsystems such as berths. For example, vessels may have been left idle at times because congestion had developed in other parts of the terminal such as the stacking areas. However the relatively poor use of berth space probably indicates that there was an oversupply of berth space relative to the supply of some other terminal subsystems. This is perhaps not unexpected in view of the restricted site areas available for each terminal.

A final judgement on whether the container handling rates realised at the Glebe Island and Seatainer terminals from 1977 to 1981 were good, bad or indifferent must wait until data becomes available either from other first generation terminals (in Australia or overseas) or from new second generation terminals designed with the help of the lessons learnt at terminals such as those at Glebe Island and White Bay.

APPENDIX I—ABBREVIATIONS AND DEFINITIONS

Athwartship	Across the ship, at right angles to the fore-and-aft centreline.
DWT	Deadweight tonnes; the total weight in tonnes that a ship carries on a specified draft (usually the summer draft) including cargo, fuel, water in tanks, stores, baggage, passengers and crew and their effects but excluding water in the boilers.
FCL	Full container load.
GIT	Glebe Island terminal.
ITV	Internal transfer vehicle; a generic term used to describe a vehicle used for transferring containers from the wharf area to the stacking area or within the stacking area.
LASH	Lighter aboard ship; a barge (lighter)—parent ship combination whereby the barge is lifted onto the parent ship for deep sea voyages.
LCL	Less than container load.
Portainer	Portainer crane; a travelling gantry crane used for transferring containers on and off ship. Portainer cranes run on rail tracks laid along the wharf area. The name derives from the trade name used by Paceco Incorporated, USA for its ship-to-shore container cranes.
Ro-ro	Roll-on roll-off (vessel).
TEU	Twenty-foot equivalent unit; a container counting unit based on the International Standards Organisation (ISO) 20 feet by 8 feet by 8 feet container.
Transtainer	Transtainer crane; a travelling gantry crane used for moving containers in the container stacking area. Glebe Island transtainer cranes run on pneumatic tyres which allow for some maneouvrability. The name derives from the trade name used by Paceco Incorporated, USA for its container handling cranes.
STL	Seatainer Terminals Limited terminal at White Bay.
Straddle carrier	A particular type of internal transfer vehicle. These carriers lift containers from the 'straddle' position and can commonly stack up to three high.

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