CONTAINER TERMINAL PRODUCTIVITY IN PORT JACKSON AND PORT BOTANY

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ABSTRACT:

Until recently, little data have been available on container terminal productivity in Australia or overseas. This paper describes the results of an analysis of the productivity of the first-generation Glebe Island and Seatainer terminals in Port Jackson from 1977 to 1981 and the CTAL terminal in Botany Bay in 1983.

The average handling rate for both the Port Jackson terminals was about 9 TEUs per hour of vessel alongside time, but about 16 TEUs per hour for the CTAL terminal. These and other measures of terminal productivity are discussed, as are terminal demand and operational characteristics. The paper also summarises the factors which influenced the development of container terminals in Port Jackson and Botany Bay.

INTRODUCTION

During the 1960s, it became apparent that changes in the shipping and cargo handling industries would require complementary changes in both port structure and operations. The Seatainer and Glebe Island terminals in Port Jackson were part of the resultant rapid response to the need to provide adequate facilities for the new container vessels introduced into Australia's trading routes and were developed in an atmosphere of urgency and uncertainty about port infrastructure requirements.

The Seatainer terminal at White Bay was opened in March 1969, followed in February 1973 by the Glebe Island terminal, which was designed as a common-user facility. Together, these two purpose-built container complexes were the focus of cellular container operations in Sydney until early in the 1980s.

Rapid growth rates in containerised cargo, together with favourable changes in exchange rates and tariff regulations during 1973, led to all of Sydney's cargo handling facilities being inundated with imports. The severe congestion which resulted underlined the need for improved cargo handling facilities and, in 1974, the decision was made to proceed immediately with the development of container facilities in Botany Bay. There were many delays because of the highly sensitive nature of major infrastructure development on the foreshores of Botany Bay and it was not until March 1980 that the Australian National Line terminal in Port Botany became operational, followed by the Container Terminals Australia Limited (CTAL) terminal in February 1982.

This paper notes briefly the factors which influenced the development of container terminals in Port Jackson and Botany Bay and describes some of the results of analyses of the productivity of the Seatainer and Glebe Island terminals from 1977 to 1981 and the CTAL terminal in 1983. The main sources of data for these analyses were the management records of the terminal operators. The detailed results of the separate studies of the Port Jackson and Botany Bay terminals are contained in two Bureau of Transport Economics (BTE) publications, BTE (1984) and BTE (1985).

THE DEVELOPMENT OF CONTAINER TERMINALS IN PORT JACKSON AND PORT BOTANY

By the early 1960s, it was becoming increasingly clear that changes in shipping technology, largely in response to rapidly growing volumes of cargo and escalating handling costs, would require both structural and operational changes in ports. The initial response of port authorities was the replacement of jetties and finger piers by consolidated, longshore berth complexes. For shipowners, the rationalisation of cargo into modules led to the introduction of roll-on/roll-off (ro-ro) and cellular container vessels requiring new, specialised and capital-intensive port facilities.

The Development of Container Terminals in Port Jackson

The attempt to achieve more efficient general cargo handling operations in Port Jackson centred around Darling Harbour and started with the reconstruction of Berth 7 in March 1963. Designed specifically as a ro-ro berth, it was completed in mid-1964 and, together with three longshore berths with a total area of 10 hectares, represented the first stage of a general 10-year redevelopment plan (Maritime Services Board 1974b). By 1965, a second berth had been completed and an area of 3.4 hectares at Mort Bay leased to the Australian National Line (ANL) for development as a ro-ro terminal.

The formation of two consortia of shipowners, Overseas Containers Limited (OCL) and Associated Container Transportation Limited (ACT), in London in September 1965 caused a flurry of activity, apprehension and uncertainty in Australian ports, which resulted in the McEwen conference on containerisation in early May 1966. Action was seen to be hampered by the lack of firm proposals and detailed timetables from shipping companies, leaving ports with tentative plans requiring considerable flexibility. Authorities recognised that new, larger areas would most likely be required in the future, but were cautious about committing capital for new port areas (Department of Trade and Industry 1966).

In September 1966, the Maritime Services Board (MSB) released a 10-year redevelopment plan for Port Jackson, which specifically recognised the need to accommodate the demands of containerisation, but reflected the prevailing uncertainty as to ship type and berth layout in its flexibility. The focus of container operations was to be the White Bay foreshore of the Balmain Peninsula (Maritime Services Board 1966). Details for the new terminal were sketchy and were modified as OCL progressively realised its plans.

In early 1966, Seatainer Terminals Limited (STL), which was owned by a number of shipping companies including the Australian subsidiary of OCL, began negotiations with the MSB for a 3.2 hectare, two-berth site in White Bay. Later, when OCL and ACT agreed to operate an integrated Australia/Europe service, the site was expanded to 4.9 hectares (Brotherson 1967). Work began in January 1967 and the two berths were completed by the end of 1968. A further 3.2 hectares and 850 metres of berth frontage were made available and a third berth was opened in March 1969.

The two other areas specified for container development were the 3.4 hectare site leased earlier to ANL in Mort Bay and Berths 7 to 10 in Darling Harbour, already part of a general reconstruction program. The two-berth terminal at Glebe Island was not part of the MSB's 1966 ten-year plan. The contract for the development of the terminal was let in November 1970, with the terminal opening as a common-user facility in February 1973. It was initially operated by the MSB, but in November 1974 Glebe Island Terminals Proprietary Limited took over the operation.

The Development of Container Terminals in Port Botany

In May 1961, the MSB obtained jurisdiction over Botany Bay as a potential site for future port development, in view of the inadequacy of Port Jackson for the development of extensive bulk handling areas and the forecast increases in ship size (Brotherson 1969).

After numerous technical investigations, the dredging of port approaches and initial land reclamation started in June 1971 and was completed in October 1973. The highest priority for the project at that time was the provision of adequate facilities for bulk shipping, though it was recognised that container facilities would be extended into Botany Bay when the need arose.

By 1974, the facilities in Port Jackson had become extremely congested, resulting in long delays to shipping and cargo and widespread and vocal user dissatisfaction. As a result of this congestion, the MSB gave urgent and detailed consideration during 1973 to the possibility of including new container terminal areas within the new Botany Bay reclamations and by early 1974 decided to set aside 81 hectares for container operations with sufficient wharf face to accomodate six large container vessels (Maritime Services Board 1974b).

In March 1974, the MSB called for applications for the lease of the proposed new sites and ANL and STL began negotiations for the lease of the container terminal area. In December 1975, an agreement for lease of the northern terminal was signed with ANL, but it was not until February 1978 that an agreement was signed for the second terminal with Container Terminals Australia Limited (CTAL), a newly-formed company resulting from changes in the corporate structure of STL.

Because of the phasing of the reclamation work, only one terminal could be completed at a time and, since ANL was perceived to have the more pressing need, it was agreed that development of that terminal would take precedence over the one for CTAL, delaying CTAL construction for one or two years.

However, the long and complex process of major infrastructure development was further complicated by political change and the processes of decision-making. As a result, it was not until January 1977 that the New South Wales Government gave approval for construction of the container terminals to proceed. The ANL terminal was opened in December 1979, commencing operations in March 1980. It was another two years before the CTAL terminal began operating in February 1982.

The Growth of Container Traffic Through Sydney

Details of the number of vessel calls by cellular container and ro-ro vessels from 1968-69 to 1982-83 are given in Table 1. From 1969-70, the first full year of cellular container operations in Sydney, to 1982-83, container vessel calls increased at an average rate of 11 per cent per year, whereas calls by ro-ro vessels increased at an average rate of 2 per cent per year.

TABLE 1-CALLS BY CELLULAR CONTAINER AND RO-RO VESSELS AT PORT JACKSON AND BOTANY BAY; 1968-69 TO 1982-83

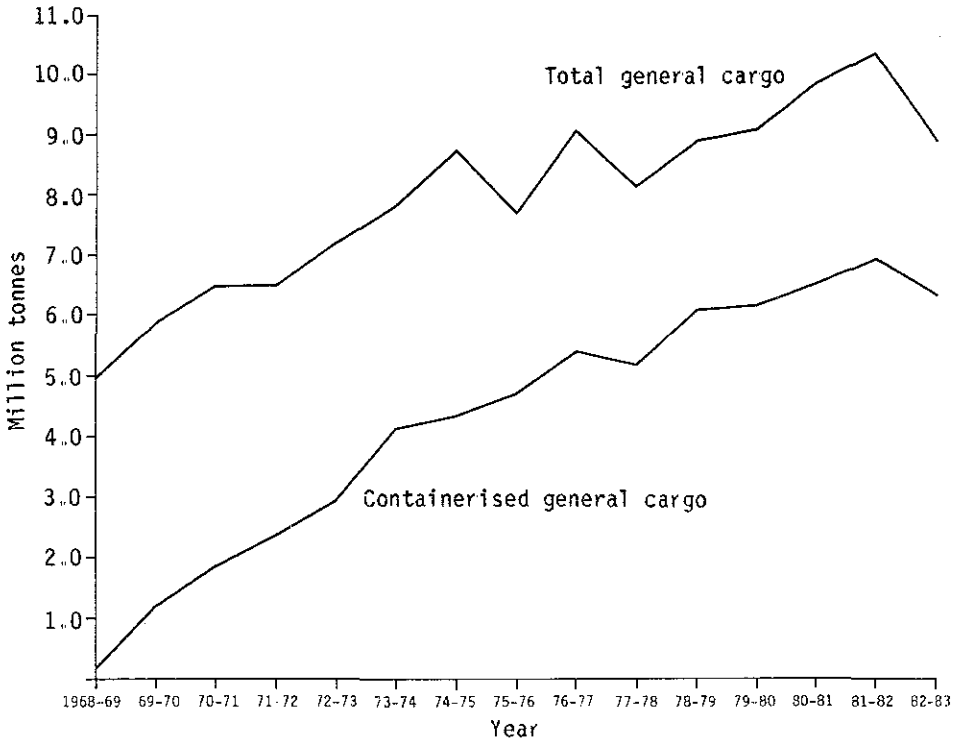
(number of vessel calls per year)

	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	937
1982-83	261	188	299	98	846

(a) Container terminal operations commenced in March 1980.

Source: Maritime Services Board, *Port Statistics*, 1968-69 to 1982-83.

The amount of general cargo passing through Sydney between 1968-69 and 1982-83, together with details of containerised cargo, are shown in Figure 1. Over this 14-year period, the general cargo trade increased by an average rate of 4 per cent per year. However, over the same period, the average annual growth rate for containerised cargo was 30 per cent, with the proportion held by containerised cargo in the general cargo flow growing from 3 per cent to 71 per cent.



Source: MSB, *Port Statistics*, 1968-69 to 1982-83.

Figure 1-General cargo trade through Port Jackson and Port Botany from 1968-69 to 1982-83

The numbers of containers handled at each of the main container terminals in Sydney from 1969-70 to 1982-83 are given in Table 2. Over this 13-year period, the number of containers handled annually in Sydney more than quadrupled. The high growth rates experienced in the early 1970s were not sustained, with average annual increases of 23 and 7 per cent for the first and second halves of the decade respectively. The generally depressed trading conditions prevailing after 1981 are illustrated by decreases in both the total general cargo flow (see Figure 1) and the total number of containers handled in 1982-83.

TABLE 2-CONTAINERS HANDLED AT FACILITIES IN PORT JACKSON AND BOTANY BAY; 1969-70 TO 1982-83

(TEUs)

	Port Jackson					
Year	White Bay	Glebe Island	Mort Bay	Other berths	Botany Bay	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	106 314	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	364 862
1980-81	87 023	80 462		104 823	111 272	383 005
1981-82	51 772	84 836		122 338	149 848	408 792
1982-83		59 771		111 119	200 877	371 767

Sources: For 1969-70 to 1978-79, Maritime Services Board (1981b); for 1979-80 to 1982-83, personal communication from the Maritime Services Board.

CHARACTERISTICS OF SHIP AND CONTAINER TRAFFIC

Uncertainty and urgency characterised the introduction of containerisation into Australian ports and both the STL and Glebe Island terminals were products of these two factors. Their designs were largely conditioned by the response to old city port locations of British shipowners in the new consortia and were very similar to those for terminals being built in United Kingdom ports, in which alongside space was extremely limited. When

the new STL 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 serviced by a dedicated rail service.

At Glebe Island, space was also limited, but in the four years since the construction of the STL terminal, container terminal design had become more flexible and innovative and a low level stacking, transtainer operation was adopted. Although there was a rail link to two inland depots, these depots were not an integral part of operations and road receivals and deliveries were very important.

Thus, although both terminals had restricted sites and were in adjacent inner city locations, they were still quite different in many respects from each other and from the CTAL terminal in Port Botany. The new terminal, with a total site area of 38.6 hectares, is almost twice the area of the two original Port Jackson terminals together. It has three times the operating area and twice the berth space of the Glebe Island terminal and is a 'state of the art' terminal for the late 1970s.

Ship Characteristics

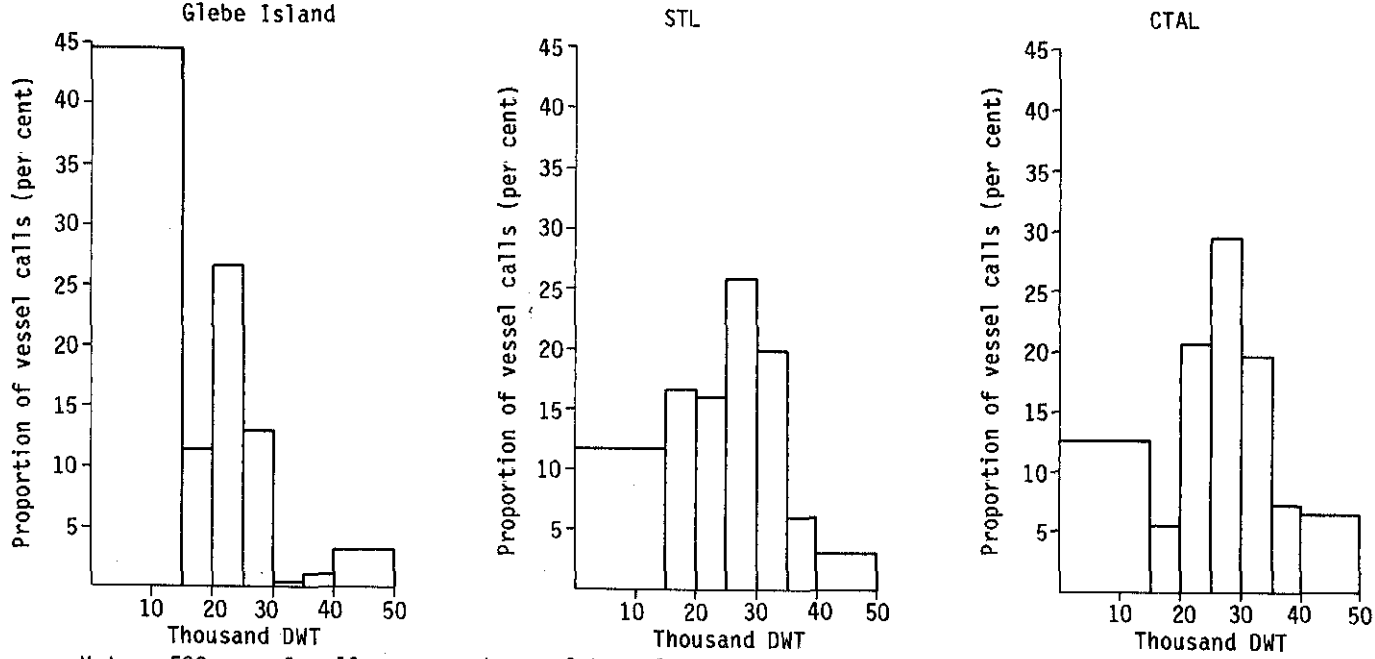
There were also sharp contrasts between the vessels which used the three terminals. As a common-user terminal, Glebe Island was obliged to service any vessel on demand. Therefore, the types of ships ranged from the latest generation of specialised container vessels to converted general-purpose cargo vessels of every size and configuration. STL mainly serviced the first and second generation container vessels employed by the two consortia, OCL and ACT, operating the Australian/United Kingdom conference service. Similarly, the 25 vessels using the CTAL terminal on a regular basis were operated by three major consortia.

The distributions of vessel sizes for vessel calls at each terminal are shown in Figure 2. Almost 80 per cent of vessels using the STL terminal from 1977 to 1981 were between 16 000 and 35 000 DWT, compared with 51 per cent for Glebe Island. For the CTAL terminal in 1983, almost 80 per cent of vessels serviced were between 20 000 and 40 000 DWT, although the modal class, 26 000 to 30 000 DWT, was the same as for the STL terminal. Over 50 per cent of vessels using Glebe Island were less than 20 000 DWT, compared with 28 per cent for STL and 18 per cent for CTAL.

Characteristics of Container Traffic

Table 3 lists the parameters of the container traffic handled by each of the three terminals. Because of the large relative errors involved, care needs to be taken in interpreting the figures. However, they do reveal some of the basic characteristics of the container flows.

On average, 413 containers were handled per vessel call at the Glebe Island terminal, compared with 768 for both the STL and CTAL terminals. Of these totals, import containers made up about 57 per cent of the average load per vessel call for all three terminals, underscoring the imbalance between exports and imports in the Sydney container trade. The preponderence of 20 foot containers in the Australian trades generally is also evident from the Table.



Note: 582 vessel calls were made to Glebe Island, 399 to STL and 113 to CTAL.

Sources: BTE (1984 and 1985).

Figure 2-Distributions of vessel sizes for vessel calls at Glebe Island and STL terminals for 1977, 1979 and 1981 and CTAL terminal for 1983

TABLE 3-PARAMETERS OF CONTAINER TRAFFIC FLOWS AT THE GLEBE ISLAND, STL AND CTAL TERMINALS

(TEUs per ship call)

Container traffic	Glebe Island		STL[a]		CTAL[b]	
	mean	sd	mean	sd	mean	sd
Imports						
20 foot	182	na	361	na	367	178
40 foot	48	na	59	na	62	46
Total	230	145	439[c]	236	429	211
Exports						
20 foot	134	na	240	na	277	174
40 foot	49	na	55	na	62	72
Total	183	123	329[c]	187	339	200
Total imports and exports	413	230	768	384	768	383
Restows	13	26	17	29	18	33

(a) For the three sample years 1977, 1979 and 1981.
(b) For 1983.
(c) These totals include reefer and over-dimension containers.

sd standard deviation
na not available

Note: Sample sizes were 582, 399 and 113 vessel calls for Glebe Island, STL and CTAL respectively.

Sources: BTE (1984) and BTE (1985).

Vessel calls at Glebe Island were also characterised by a larger proportionate load variability than those using either the STL or CTAL terminals, a partial reflection of the vessel size distributions and container traffic patterns noted earlier. The standard deviation was 63 per cent of the mean for import containers and 67 per cent for export containers, compared with 54 and 57 per cent respectively for STL and 49 and 59 per cent respectively for CTAL.

Figure 3 shows the distributions of the number of containers handled per vessel call at each of the three terminals and, once again, highlights the differences between the common-user and more conference-oriented terminals. Significantly smaller loads were characteristic of vessel calls at Glebe Island, with 71 per cent involving 500 or less containers, compared with 31 per cent and 24 per cent of vessel calls at STL and CTAL respectively. At the other end of the scale, just over 2 per cent of vessel calls involved more than 1000 containers at Glebe Island, with comparative figures of 31 and 28 per cent for STL and CTAL respectively.

VESSEL TIMES AND CONTAINER HANDLING RATES

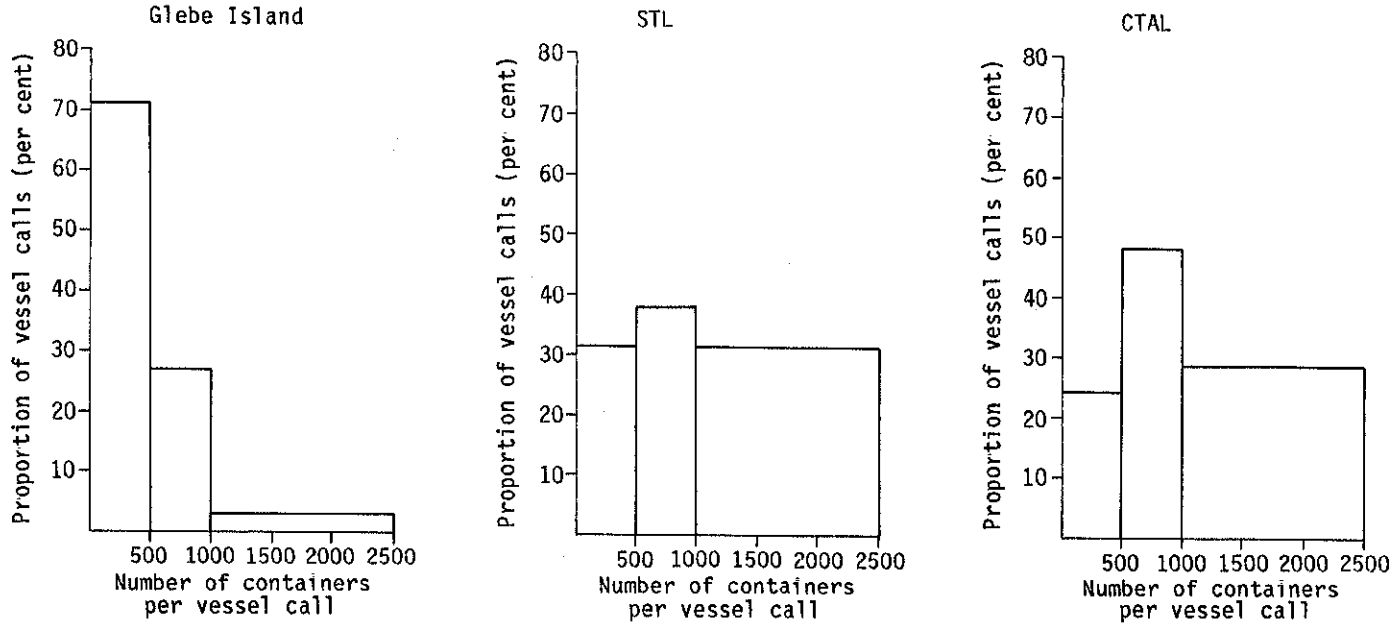
The time a vessel spends in port is critical to vessel costs. Clearly, terminal handling rates and productivity are important in this respect and are influenced not only by the number of vessels demanding service and the tightness of vessel schedules, but also by the operational efficiency of the terminal itself.

Due to differences in the data collection procedures used at each terminal, it had not been possible to use a completely consistent set of time and productivity measures in the two studies of the Port Jackson and Port Botany container terminals (BTE (1984) and BTE (1985)). However, two time measures, alongside time and container exchange time, and hence two productivity measures, alongside handling rate and net container handling rate, were identical and are compared in this Section.

Vessel Times

Alongside time refers to the total time spent by a vessel at berth and, as such, includes factors exogenous to the technical capability of the terminal operating system. Table 4 and Figure 4 give comparisons of the statistical distributions and parameters of alongside time for the three terminals. Although the time periods are different, they provide a useful indication of the differences between the older terminals and the new one in Botany Bay.

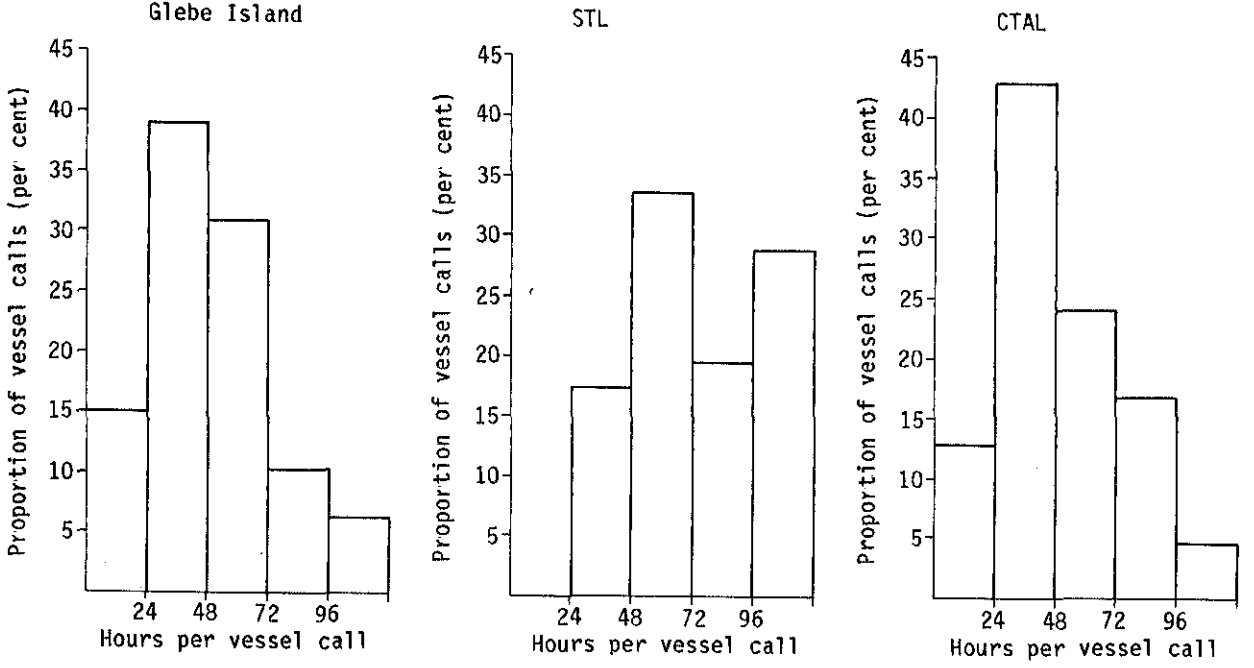
Over the three years 1977, 1979 and 1981, the average alongside time at the STL terminal was 94 hours, with a median of 76 hours. For vessels using the CTAL terminal in 1981, the average was 51 hours, with a median of 48 hours. Moreover, more than half the vessels spent two days or less at CTAL compared with only 15 per cent for STL and 30 per cent of the vessels remained at the STL terminal for more than four days compared with just over 4 per cent for CTAL.



Note: 582 vessel calls were made to Glebe Island, 399 to STL and 113 to CTAL.

Sources: BTE (1984 and 1985).

Figure 3-Distributions of the number of containers handled per vessel call at Glebe Island and STL terminals for 1977, 1979 and 1981 and CTAL terminal for 1983



Sources: BTE (1984 and 1985).

Figure 4-Comparison of vessel alongside time distributions for the Glebe Island, STL and CTAL terminals

TABLE 4-COMPARISON OF VESSEL ALONGSIDE TIME PARAMETERS FOR THE GLEBE ISLAND, STL AND CTAL TERMINALS

(hours per vessel call)

Measure	Glebe Island[a]	STL[a]	CTAL[b]
Mean	54.2	94.0	50.6
Standard deviation	41.7	80.5	24.7
Median	45.7	76.3	47.7

(a) Averaged over the years 1977, 1979 and 1981.
(b) For 1983.

Sources: BTE (1984) and BTE (1985).

Container exchange time (actual handling time exclusive of all delays) is the most precise measure of the actual time spent handling containers and is available for both the STL and CTAL terminals. Table 5 gives a comparison of the container exchange time parameters for these two terminals and it shows that the average time spent handling containers at the CTAL terminal in 1983 was 17.2 hours per vessel call, less than half that for the STL terminal over the years 1977, 1979 and 1981.

Container Handling Rates

The alongside handling rate is defined as the total number of containers, expressed as TEUs, handled per hour of alongside time. As no allowance is made for any sort of delay, the rate is a general measure of terminal productivity during the vessel's stay.

Table 6 gives a comparison of the alongside handling rate parameters for the three terminals. The two Port Jackson terminals had very similar characteristics, but were vastly different from the one in Port Botany. Over the three years 1977, 1979 and 1981, the average alongside handling rate for Glebe Island and STL was 9.4 TEUs per hour, with a median of approximately 9. For the CTAL terminal in 1983, the rate was 16.2 TEUs per hour, with a median of 15.3.

TABLE 5-COMPARISON OF CONTAINER EXCHANGE TIME PARAMETERS FOR THE STL AND CTAL TERMINALS

(hours per vessel call)

Measure	STL[a]	CTAL[b]
Mean	36.8	17.2
Standard deviation	21.8	8.0
Median	34.6	16.3

(a) Averaged over the years 1977, 1979 and 1981.
(b) For 1983.

Sources: BTE (1984) and BTE (1985).

TABLE 6-COMPARISON OF ALONGSIDE HANDLING RATE PARAMETERS FOR THE GLEBE ISLAND, STL AND CTAL TERMINALS

(TEUs per hour of alongside time)

Measure	Glebe Island[a]	STL[a]	CTAL[b]
Mean	9.4	9.4	16.2
Standard deviation	4.7	4.6	5.9
Median	8.7	9.2	15.3

(a) Averaged over the years 1977, 1979 and 1981.
(b) For 1983.

Sources: BTE (1984) and BTE (1985).

The net container handling rate is defined as the total number of containers, expressed as TEUs, handled per hour of container exchange time and represents the handling rate achieved when all delays are omitted. Table 7 gives a comparison of the net container handling rate parameters for the STL and CTAL terminals and shows that, in 1983, the new terminal handled containers at an average rate of 45.5 TEUs per hour, slightly more than double the rate, 21.5 TEUs per hour, at the STL terminal over the years 1977, 1979 and 1981.

TABLE 7-COMPARISON OF NET CONTAINER HANDLING RATE PARAMETERS FOR THE STL AND CTAL TERMINALS

(TEUs per hour of container exchange time)

Measure	STL[a]	CTAL[b]
Mean	21.5	45.5
Standard deviation	6.4	13.3
Median	21.0	47.4

(a) Averaged over the years 1977, 1979 and 1981.
(b) For 1983.

Sources: BTE (1984) and BTE (1985).

Discussion

Even with the improvements in vessel alongside times and the increases in productivity experienced at the CTAL terminal, it is clear that a vessel still spends a large amount of its time at berth idle. As a proportion of average alongside time, average container exchange time was 33 per cent for the CTAL terminal in 1983, compared with 39 per cent for the STL terminal over 1977, 1979 and 1981.

For the Port Jackson terminals, quite fundamental constraints were imposed by the small land area available for each terminal and limited site access, resulting in bottlenecks in the landside handling operations and increased container handling time. On the other hand, operations at the CTAL terminal were affected by the generally depressed trading conditions experienced during 1983.

It is important to note that included in alongside times are various operational and non-operational delays, some of which are part of container vessel operations and are unavoidable. This category includes time lost as a result of handling breakbulk cargo and lashing and unlashing containers. Alongside time also includes the midnight shift, which is generally not worked, and time lost due to unfavourable weather and equipment breakdown. To illustrate this point, the time lost for the average vessel call at the CTAL terminal in 1983 included (see BTE (1985)):

- 10.7 hours as a result of not working the midnight shift;
- 4.3 hours due to shift changes, although this has since been eliminated;
- 4.0 hours waiting to sail;

- 2.0 hours waiting for labour to board;
- 1.8 hours due to industrial disputes;
- 0.8 hours for the handling of breakbulk cargo; and
- 0.7 hours due to smokos and breaks.

The majority of these delays cannot be significantly reduced. However, delays due to shift changes, industrial disputes and smokos and breaks are all amenable to reduction.

CONCLUDING REMARKS

Both the STL and Glebe Island container terminals were designed and built in response to the introduction of new general cargo handling techniques in the 1960s. Many of the lessons learnt from these and other first generation terminals were incorporated into the design of the CTAL terminal. As a consequence, the shorter times spent at berth and the significantly higher container handling rates experienced by vessels using the CTAL terminal were not unexpected.

Average vessel alongside time was 51 hours at the CTAL terminal in 1983 compared with 94 hours for the STL terminal over the years 1977, 1979 and 1981. The actual time per vessel call available for handling containers was 17 hours for CTAL against 37 hours for STL. Container handling rates were also significantly different, with average alongside handling rates of 16.2 TEUs per hour for CTAL and 9.4 TEUs per hour for both STL and Glebe Island. The average container handling rates were 45.5 TEUs per hour and 21.5 TEUs per hour at the CTAL and STL terminals respectively.

Nevertheless, despite the improvements, the amount of time a vessel spent idle at berth remained high. As a proportion of average alongside time, average container exchange time was 33 per cent for the CTAL terminal, which is not a significant improvement over the 39 per cent for the STL terminal. While some of this lack of improvement is the result of depressed trading conditions in 1983, it is clear that operations at the CTAL terminal are being constrained by avoidable delays in the operating environment which can limit the productivity of even sophisticated container terminal systems.

REFERENCES

Brotherson, W.H. (1967), *The Port of Sydney - Container Facilities*, Paper given at a Forum conducted by the Australian Institute of Management, Sydney, July 1969, Sydney, p3.

_____ (1969), *Historical Aspects of the Port of Botany Bay*, Paper presented to the Seminar on the Development of Botany Bay as an Industrial Port Complex, Sydney, October 1969, Maritime Services Board, Sydney.

Bureau of Transport Economics (1984), *Container terminal productivity in Port Jackson: A study of Glebe Island and Seatainer terminals from 1977 to 1981* (in press).

_____ (1985), *Container terminal productivity in Port Botany: A study of the CTAL terminal, 1983* (in preparation).

Department of Trade and Industry (1966), *Report: Shipping Conference - Containerisation*, DTI Trade Publicity Branch, Melbourne, Supplement to Overseas Trading, Volume 18, Number 11.

Maritime Services Board (1966), *A Ten Year Port Redevelopment Plan*, Maritime Services Board, Sydney, p16.

_____ (1969-83), *Port Statistics*, 1968-69 to 1982-83, Maritime Services Board, Sydney.

_____ (1974b), *Darling Harbour Redevelopment*, Maritime Services Board, Sydney.

_____ (1981b), *Submission to the Kyeemagh-Chullora Road Inquiry*, Sydney.

ABBREVIATIONS AND DEFINITIONS

DWT	Deadweight tonnage; the total weight in tonnes that a ship carries on a specific 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.
Reefer	Refrigerated container.
Restow	A container which is off-loaded to allow access to containers which have reached their destination, then reloaded for transport to its destination.
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 a container stacking area.